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PHYSICS ABSTRACTS

SECTION A

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SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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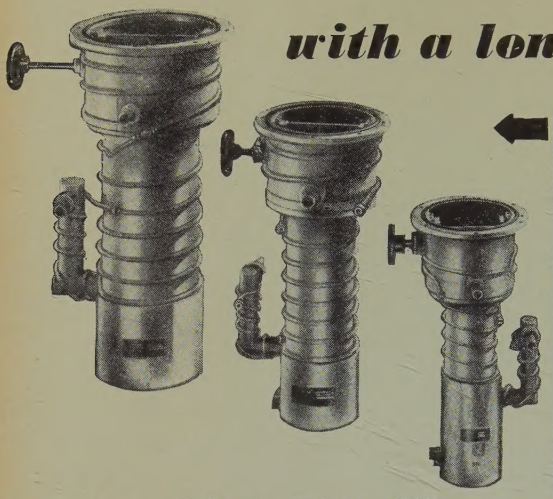

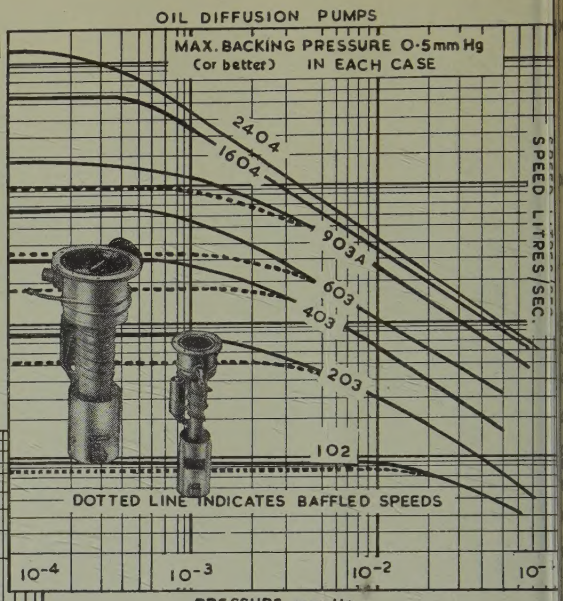

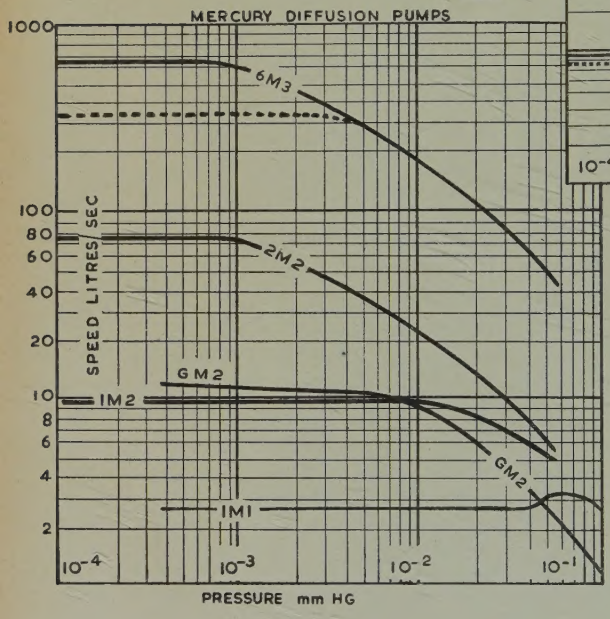

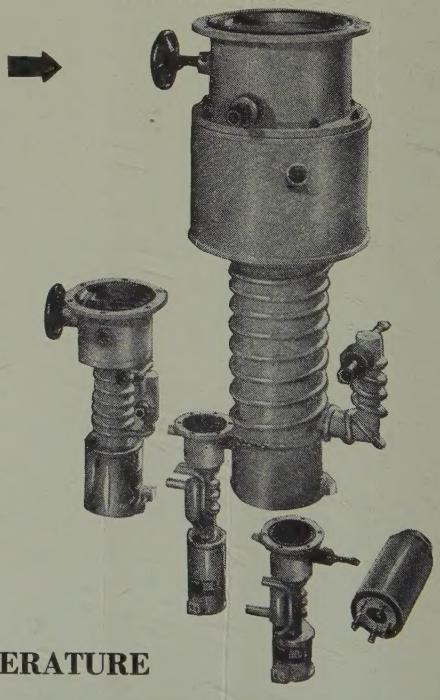

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RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

Mechanical testing
Non-destructive testing
Industrial radiography
Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Amplifiers
Radiocommunication
Mechanical engineering
Illumination
Metallurgy

LIST OF JOURNALS

The following list supplements that published with the January Number of Vol. 53 (1950). Jour marked * are not received regularly though abstracts of articles from them are occasionally published. addresses given are believed to be correct, but no responsibility can be accepted for errors.

B.C.U.R.A. Bull.	*Monthly Bulletin of the British Coal Utilization Research Associa* 13 Grosvenor Gardens, London, S.W.1.
**Contr. Crimean Astrophys. Obs.*	*Contributions of the Crimean Astrophysical Observatory.* [Abstra by the *Astronomical News Letter.*]
Fourth Wld Pwr Conf. Pap. (*Lond.*, 1950)	*Papers read before the Fourth World Power Conference, London, 1* British National Committee, World Power Conference, 2 Grand Buildings, Trafalgar Square, London, W.C.2.
**Geophys. Mem. Met. Off.*	*Geophysical Memoirs of the Meteorological Office.* H.M. Statio Office, Kingsway, London, W.C.2.
Instn Elect. Engrs, Paper	*Institution of Electrical Engineers Paper.* Savoy Place, Lond W.C.2. [To be published in *Proceedings* or other Institu publication; reference thereto given on publication. Pr usually available.]
**J. Soc. Chem. Ind., Lond.*	*Journal of the Society of Chemical Industry.* 56 Victoria Str London, S.W.1.
Marelli	*Marelli.* Ercole Marelli, Corso Venezia 16, Milan.
Tesla Tech. Rep.	*Tesla Technical Reports.* Kovo Ltd., Mezibranská 32, Prague II.
**Veröff. Bad. LandSternw. Heidelberg.*	*Veröffentlichungen der Badischen Landesternwarte zu Heidelb* (Königsstuhl). Heidelberg.
**Zh. Fiz. Khim.*	*Zhurnal Fizicheskoi Khimii.* Cherkasski Per 2, Moscow.
**Z. Met.*	*Zeitschrift für Meteorologie.* [Abstracted by *Meteorologi Abstracts.*]
**Zh. Obshch. Khim.*	*Zhurnal Obshchei Khimii.* Cherkasski Per 2, Moscow.

ORIGINAL ARTICLES

It is regretted that the articles from which abstracts are made cannot be sent out on loan. Application should be made to appropriate lending libraries or to the publisher of the Journal concerned; publishers' addresses, where known, are given in the "List of Journals" published with the January Number of Vol. 53 (1950), or in the supplementary lists published subsequently.

ERRATA

Abstr. 1721, line 2: *for* E. G. BURGE *read* E. J. BURGE.
Abstr. 1880, line 2: *for* E. BURGE *read* E. J. BURGE.
Abstr. 2880, line 5: *for* solar *read* atmospheric.
Abstr. 3191, line 1: *for* **Reactive** *read* **Reactive [radiative].**

Publications

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METEOROLOGICAL FACTORS IN RADIO-WAVE PROPAGATION

Report of a Conference held jointly by the Physical Society and the Royal Meteorological Society, 1946.

REPORT OF INTERNATIONAL CONFERENCE ON FUNDAMENTAL PARTICLES (Vol. I) and LOW TEMPERATURES (Vol. II), Cambridge, 1946

THE EMISSION SPECTRA OF THE NIGHT SKY AND AURORAE

Papers read at an International Conference held under the auspices of the Gassiot Committee, London, July, 1947.

THE STRENGTH OF SOLIDS

Report of Conference, Bristol, July, 1947.

RESONANT ABSORBERS AND REVERBERATION

Report of the 1947 Summer Symposium of the Acoustics Group of the Physical Society.

NOISE AND SOUND TRANSMISSION

Report of the 1948 Summer Symposium of the Acoustics Group of the Physical Society.

Prices will be supplied on application.

Reduced prices are allowed to members of the Physical Society on all the above publications.

THE PHYSICAL SOCIETY,

1 Lowther Gardens, Prince Consort Road, London, S.W.7.

MATHEMATICS 51

517.52 : 538.566

5405. A general account of asymptotic expansions in wave propagation. T. KAHAN AND G. ECKART. *Rev. Sci., Paris*, **87**, 3–24 (*Jan.–Feb.*, 1949) *In French.*

This review for physicists starts with an account of the properties of asymptotic expansions of a function, followed by general theorems on the expansion of integrals. The method of steepest descents and that of the stationary phase are discussed in considerable detail. G. J. KYNCH

517.521.5

5406. On a generalized Kelvin's series. L. C. HSU. *Sci. Rep. Nat. Tsing Hua Univ.*, **5** (*No.* 3) 280–8 (1949).

A multiple Kelvin's series is considered with the general term of the form

$$(-)^{\Sigma m} f(m_1) \ldots f(m_k)/(m_1 + \ldots + m_k)^s$$

where s is a complex number and $f(x)$ is an arbitrary polynomial. A general sum formula and various convergence conditions are established. A.

517.6

5407. Numerical evaluation of integrals of the form $I = \int_{x_1}^{x_2} f(x)e^{i\varphi(x)}dx$ and the tabulation of the function

$$\mathrm{Gi}(z) = (1/\pi)\int_0^\infty \sin(uz + \tfrac{1}{3}u^3)du.$$

R. S. SCORER. *Quart. J. Mech. Appl. Math.*, **3**, 107–12 (*March*, 1950).

517.9

5408. On the convergence of the perturbation method. I. T. KATO. *Progr. Theor. Phys.*, **4**, 514–23 (*Oct.–Dec.*, 1949).

The perturbation theory is shown to be justified for a self-adjoint but not necessarily bounded operator in Hilbert space, which is regular in a defined sense. A sufficient condition for regularity is established and the radius of curvature found approx. As an example, the conditions for the Matthieu equation $u'' + (\lambda + \mu \cos 2x)u = 0$ are given. G. J. KYNCH

517.944

5409. A note on Riemann's method applied to the diffusion equation. J. W. MILES. Note in *Quart. J. Appl. Math.*, **8**, 95–102 (*April*, 1950).

518.5 : 539.17

5410. An analog computer. J. G. BAYLY. *Rev. Sci. Instrum.*, **21**, 228–31 (*March*, 1950).

An integrator has been constructed which is capable of computing the yield of nuclear reactions produced by radiation of intensity that varies arbitrarily with time. By combining the appropriate number of such machines the yield resulting from a series of consecutive reactions may be found. The instrument may also be used wherever the quantity (x) to be determined is governed by the differential equation $dx/dt = -\lambda x + f(t)$, $f(t)$ being a given function of the time, and λ a known constant. A.

518.5

5411. High speed digital computers. An elementary survey of present developments and future trends. L. N. RIDENOUR. *J. Appl. Phys.*, **21**, 263–70 (*April*, 1950).

518.5 : 513.76

5412. Transformation between spherical map-projections by mechanical and optical devices. C. BERNASCONI. *Geofis. Pura. Appl.*, **15**, 227–35 (*Oct.–Dec.*, 1949) *In Italian.*

Mechanical linkages may be connected to a differential analyser to produce the functions required when a map is redrawn in a new projection. Linkages are suggested for some common cases. The errors occurring when they are used to make a pen follow the motion of a tracing point are estimated. The use of a photo-electric scanning head coupled to a modulated light source may reduce the errors and greatly increase the speed with which a map may be transformed. S. MICHAELSON

518.5 : 548.734

The use of punched cards in molecular structure determinations. III. Structure-factor calculations of X-ray crystallography. *See Abstr.* 6165

518.5 : 548.734

An improved punched-card method for crystal structure-factor calculations. *See Abstr.* 6166

518.5 : 548.734

A Hollerith technique for computing three-dimensional differential Fourier syntheses in X-ray crystal-structure analysis. *See Abstr.* 6167

518.5 : 621.318.572

5413. On a general type of algebraic calculator. F.-H. RAYMOND. *Ann. Télécommun.*, **5**, 2–20 (*Jan.*, 1950) *In French.*

The machines described, which are distinct from arithmetic computors, are fundamentally electronic servomechanisms solving matrices set up on electric networks. Type (1) solves up to 10 simultaneous equations, the variable quantities being resistance and voltage. The problem of the stability of the system is reduced to matrix formulation. Errors are shown to increase as the power $\frac{3}{2}$ of the order of the system to be solved. Various applications (e.g. the study of real and complex functions) are considered. Type (2) is a generalization of (1), handling 4 matrices, and designed for differential and integral equations. A multiplier/divider together with a function generator enable the solution of non-linear equations. Applications and precision are discussed. A. J. KENNEDY (R)

518.5 : 621.318.572

5414. Description of an automatic data-analysing machine. B. S. BENSON. *Mech. Engng, N.Y.*, **72**, 285–8 (*April*, 1950).

Describes a device for evaluation of telemetered and other records which take the form of lines of varying length on film. It consists of a film projector

and screen associated with a photocell, counting circuits and measuring networks.

519.281.2 : 621.391

5415. A simplified derivation of linear least square smoothing and prediction theory. H. W. BODE AND C. E. SHANNON. *Proc. Inst. Radio Engrs*, **38**, 417–25 (*April*, 1950).

The central results of the Wiener–Kolmogoroff smoothing and prediction theory for stationary time series are developed by a new method. The approach is motivated by physical considerations based on electric circuit theory and does not involve integral equations or the autocorrelation function. The cases treated are the "infinite lag" smoothing problem, the case of pure prediction (without noise), and the general smoothing prediction problem. The basic assumptions of the theory are discussed in order to determine its applicability and to avoid possible misapplication. A.

519.4 : 621.

5416. Remarks on the basis of network thee R. M. REDHEFFER. *J. Math. Phys.*, **28**, 237 (*Jan.*, 1950).

A linear object in a transmission line is speci by a 4-parameter symbol (quadruple) containing left- and right-hand complex transmission reflection coefficients. Combination of two obj is represented by formal multiplication of the qu ruples under rules derived from classical netw theory. This defines an abstract algebra of qu ruples. Certain closed sets of objects form gro under the defining multiplication and the corresp ing group theory characterizes the associated netw combinations. Particular sets are discussed in de on this axiomatic basis and many general theore follow, e.g. in the set of lossless objects, if a loss object takes a match into a match then it takes standing-wave ratio into the same standing-w ratio. B. L. COLEMAN

ASTRONOMY . ASTROPHYSICS . GEODESY 52

521.13

5417. On periodic orbits in the restricted problem of three bodies. S. W. TAYLOR. *Astr. J.*, **55**, 3–38 (*Jan.*, 1950).

521.6

5418. Motion of satellites around the sun. I. Direct or retrograde motion. II. Concavity or convexity of trajectories with respect to the sun. G. SILVA. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **2**, 228–33 (*March*); 378–83 (*April*, 1947) *In Italian.*

Motions are divided into 3 classes for which analytical conditions are set up in the form of inequalities involving the elements of planetary orbits around the sun and satellite orbits around the planet. R. A. NEWING

522.21

5419. A new type of astronomical telescope. A. COLACEVICH. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **1**, 610–15 (*March*, 1946) *In Italian.*

A spherical mirror can be corrected for spherical aberration by using a concentric meniscus lens. The power of such a system and the coefficients of primary and secondary aberration are calculated in terms of the radii and refractive index of the meniscus. The chromatic aberration introduced by the meniscus is shown to be the limiting factor in such a design. The addition, at the common centre of curvature, of a biconvex lens of power equal to that of the meniscus, yields an achromatic system without affecting the spherical correction. A telescope of this type has been made with 40 cm aperture working at $f/2{\cdot}5$. R. W. FISH

522.21 : 535.42

5420. The effect of small irregularities of surfacing in astronomical reflectors. G. TORALDO DI FRANCIA. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **3**, 568–73 (*Nov.–Dec.*, 1947) *In Italian.*

A plane mirror, with small surface irregularities distributed at random, has a plane wave incident upon it. The diffracted wave in any direction is found in terms of the co-ordinates of the diffracting parti and the direction cosines. When the mirror is cular in shape, with a very large number of diffracti elements, and the phase and amplitude due to ea equal, the expressions reduce to the well-kno Rayleigh expression for diffraction by many sm particles. R. W. FI

522.6 : 551.593

5421. Atmospheric tremor and its influence on t intensity distribution of photographic stellar imag K. GYLDENKÆRNE. *Ann. Astrophys.*, **13**, 97–1 (*Jan.–March*, 1950).

The intensity distribution in a photographic stel image is calculated as a combined effect of atmosphe tremor and scattering in the photographic plate. It assumed that the tremor causes a Gaussian distrib tion of the light intensity in the focal plane and th the intensity produced through the scattering of t light illuminating a given elementary area decreas exponentially with the distance from that area.

522.612 : 523.746 : 535.

5422. The use of Savart fringes in the observation Zeeman effects in sunspots. Y. ÖHMAN. *Astrophys.*, **111**, 362–5 (*March*, 1950).

Preliminary results of observations of sunspots a presented. Various applications of the principle a suggested, and attention is drawn to the use of subtractive double monochromator with narr slit.

522.6

5423. The compensation for seeing in stellar phot electric spectrophotometry. W. A. HILTNER AN A. D. CODE. *J. Opt. Soc. Amer.*, **40**, 149–52 (*Marc* 1950).

A method for the compensation of a variable lig source in photoelectric spectrophotometry is presente The outputs of a scanning photo-cell and a monitori cell are fed to two amplifiers. The outputs of the amplifiers are then fed to a self-balancing recordi

potentiometer. The equipment has laboratory as well as astrophysical applications. The limiting magnitude at which useful spectrophotometry with a resolution of 1 Å is approximately 4. A.

523.1 : 523.852.3

5424. The bolometric correction of the magnitudes of the galaxies in Birkhoff's cosmology. C. G. FERNANDEZ. *Comisión Impulsora y Coordinadora de la Investigación Científica (Mexico) Anuario* 1945, 51–66 (1947) *In Spanish.*

The energy received from a real galaxy, G', which recedes from an observer with constant velocity v, is compared with that received from an ideal galaxy, G, at rest relative to the observer. G and G' are intrinsically equal and equidistant from the observer at the instant of emission. The energy ratio is found to be $(1 - v)^2/(1 + v)^2$ and the difference of the bolometric magnitudes of G and G' is found to be $5[\log(1 - v) - \log(1 + v)]$. MATHEMATICAL REVIEWS

523.12 : 530.12

5425. Development of the universe. R. O. KAPP. Letter in *Nature, Lond.*, **165**, 687–8 (*April* 29, 1950).

See Abstr. 2861–2 (1950). In spite of difficulties in the author's theory of the disappearance of matter, such a theory would have the advantage of implying an upper limit to the size of mass concentrations and the rare occurrence of small concentrations, whereas on Hoyle's theory a complete range of sizes should be observable. R. A. NEWING

523.162.1 : 535.39

5426. Absorption of light in intergalactic space. M. S. EIGENSON. *Astr. J., USSR*, **26** (*No.* 5) 278 (1949) *In Russian.*

Earlier studies by the same author are reviewed. The result is that up to a distance of 10^7 ps there is no indication of intergalactic absorption. For greater distances, the author uses the Shapley–Ames data for four clusters of galaxies and finds an average photographic absorption of 0·025 mag/mps by correlating the surface brightnesses m_σ and the distances. The observations of colour indices by Stebbins and Whitford give for the selective absorption 0·007 mag/mps. The author concludes that the bright galaxies are condensations in a general "dark metagalaxy." ASTRONOMICAL NEWS LETTER

523.34 : 535.24

5427. On the photographic photometry of the surface formations of the full moon. K. GRAFF. *S.B. Öst. Akad. Wiss., Abt. IIa*, **157** (*No.* 1–5) 17–24 (1949) *In German.*

Using a plate obtained by the author in 1926 at the 60 cm refractor of the Hamburg–Bergedorf Observatory, in connection with a similar proposed programme, the work was resumed at the Vienna Observatory in collaboration with K. Haidrich. As standards served extrafocal images of α Bootis taken on this plate in such relative exposure-ratios as to give steps of 0·50 magnitudes. A Thirring Se-cell was combined with a Hartmann microphotometer and a mirror galvanometer. The probable error is given to 0·025 magn. As zero-point on the moon served the inner part of the crater Ptolemy. A list of 79 of the moon's most typical formations tabulates the values obtained for the relative brightness, and comparisons with previous results by P. Goetz (Tübingen 1930). The largest difference in contrast is found between the crater Aristarchus and the plane of Mare Tranquillitatis, namely, 1·63 magnitudes. A. BEER

523.4

5428. A relation between radius and mass and the structure of the inner planets. T. WIDORN. *S.B. Öst. Akad. Wiss., Abt. IIa*, **157** (*No.* 1–5) 101–24 (1949) *In German.*

Theoretical expressions for mass, radius and density are derived, using theories by Lipschitz and Helmert, and assuming that the inner planets are chemically uniform and that the differences are caused through differing central pressures. Comparisons with the observational data give good agreement. Five graphs illustrate the mass-radius relation, the density concentration for various planetary models, and the theoretical central densities for the inner planets. A. BEER

523.4 : 551.510.535

On the positive charges of planetary atmospheres. *See Abstr.* 6187

523.43

5429. On the existence of open bodies of water on Mars. V. G. FESSENKOFF. *Astr. J., USSR*, **26** (*No.* 5) 273 (1949) *In Russian.*

The white spots covering the polar regions of Mars are undoubtedly masses of ice, whose thickness must be small because of their rapid recession during the Martian summer. The author believes, however, that there are no open bodies of water, even of moderate size, because we fail to observe the reflection of the sun from water surfaces. Assuming a quiescent water surface of unlimited size, having the same surface curvature as Mars, he computes that the apparent magnitude of the reflected sun as seen from the earth would be $+1{\cdot}5$. The size of the water surface plays no role if 2 lines of sight to the opposite edges of the area, after reflection by the water, diverge at an angle greater than that of the sun. In this manner he finds $R_{min} = 7{\cdot}4$ km. Next, he uses data by Hecht on the visibility of point sources on an illuminated background. This leads for a 20 in telescope to a limiting magnitude of 9·0, which should still be detectable as a bright spot on the surface of Mars. Therefore, the author concludes that a body of water covering an area with a diameter of 300 m should still be detectable. He suggests that there may be no free water at all and that this may have a bearing upon the question of the existence of plant life on Mars. ASTRONOMICAL NEWS LETTER

523.44

5430. On the distribution of the poles of the orbits of small planets. L. GIALANELLA. *Atti Accad. Naz. Lincei (R.C. Cl. Sci. Fis. Mat. Nat.)* **1**, 193–8 (*Feb.*, 1946) *In Italian.*

The author re-examines the possibility, considered by Newcomb in 1862, that the influence of Jupiter on the orbits of small planets may be to draw their planes close to the plane of Jupiter's orbit and to align their principal axes parallel to those of Jupiter's orbit. By considering the distribution of the poles of the

orbits of small planets as a "rose" such as is formed by shots fired at a target, the author finds that the great condensation of points (poles of the orbits) near the centre of the target (the centrode, approximately the same as the pole of Jupiter's orbit) is greater than could be attributed to chance. He claims thereby to demonstrate the influence of Jupiter on the small planets. V. C. A. FERRARO

523.5

5431. The mechanism of the sounds from meteors. B. BARRINGER AND H. C. HART. *Contr. Meteor. Soc.*, **4** (*No.* 3) 226–32 (1949).

523.5

5432. The observation of the magnetic effect of meteors by the induction method. A. G. KALASHNIKOV. *Dokl. Akad. Nauk, SSSR*, **66** (*No.* 3) 373–6 (1949) *In Russian.*

The small magnetic fluctuations produced by meteors (Leonids, Geminids, Ursids and Quadrantids, from mid-November, 1948, until early January, 1949) was measured by means of a large induction circuit and a fluxmeter. This apparatus, described by the author in *Izv. Akad. Nauk, SSSR* [*Ser. Geog. Geofiz.* (*No.* 2) (1948)], has a sensitivity of the order of 10^{-7} oersted/mm scale deflection, while the sensitivity of the usual magnetostatic apparatus is of the order of 10^{-5} oersted/mm scale deflection.

F. ŁACHMAN

523.59 : 551.593.9

5433. The gas tail of the earth. V. G. FESENKOV. *Dokl. Akad. Nauk, SSSR*, **70** (*No.* 5) 785–7 (1950) *In Russian.*

Describes experimental work at the Gornii astrophysical laboratory near Alma-Ata on visual and photographic photometry and spectroscopy of the counterglow ("Gegenschein"). Comparison of the results with the ordinary spectrum of the night sky revealed no essential difference; as the spectrum of the night sky shows mainly emission lines, and a very faint continuous spectrum, the gaseous origin of the counterglow becomes fairly probable. It is concluded that the gas tail has the form of a truncated cone with an opening angle of about 4°, a length of the order of 100 000 km, and that the density of the gaseous matter in it is halved every 4·7 earth radii.

B. F. KRAUS

523.66

5434. A comet model. I. The acceleration of comet Encke. F. L. WHIPPLE. *Astrophys. J.*, **111**, 375–94 (*March*, 1950).

A new comet model is presented that resolves the chief problems of abnormal cometary motions and accounts for a number of other cometary phenomena. The nucleus is visualized as a conglomerate of ices, such as H_2O, NH_3, CH_4, CO_2 or CO, (C_2N_2?), and other possible materials volatile at room temperature, combined in a conglomerate with meteoric materials, all initially at extremely low temperatures ($< 50°K$). Vaporization of the ices by externally applied solar radiation leaves an outer matrix of non-volatile insulating meteoric material. Quantitative and qualitative study shows that heat transfer through thin meteoric layers in a vacuum is chiefly by radiation, that the heat transfer is inversely proportional to effective number of layers, and that an appreci time lag in heat transfer can occur for a rota cometary nucleus. Because of the time lag, suc cometary nucleus rotating in the "forward" se will emit its vaporized ices with a component tow the antapex of motion. The momentum tran from the kinetic velocity of the emitted gas propel the nucleus in the forward sense, reduce mean motion, and increase the eccentricity of orbit. Retrograde rotation can produce an accel tion in mean motion and a decrease in eccentric as observed for Comet Encke.

523.

5435. Identification of the triatomic ionized mo cule CO_2^+ in the tail of the Cunningham Co (1940c, 1941 I). P. SWINGS. *Bull. Acad. Roy. B Cl. Sci.*, **36** (*No.* 2) 113–16 (1950).

523.72 : 538.56

Transients in an ionized medium with applicati to bursts of solar noise. *See Abstr.* 5982

523

5436. A confirmation of the 22 year solar cy derived from oscillations of the solar diameter. CIMINO. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Mat. Nat.*) **1**, 624–7 (*March*, 1946) *In Italian.*

The investigation, based on observations over past 74 years, reveals also a secondary oscillation variable amplitude, and of period between 6·5 a 8·5 years. R. A. NEWT

523.7

5437. On the turbulent velocities of solar granul R. S. RICHARDSON AND M. SCHWARZSCHILD. *Astr phys. J.*, **111**, 351–61 (*March*, 1950).

A spectrum of the solar granulation was obtain showing individual granules with good definitio The Doppler shifts were measured and the cor sponding turbulent velocities determined. A tentati turbulence spectrum is derived for the solar phot sphere, which suggests the possible existence turbulent elements only 100–200 km in diamet with velocities of the order of 2 km/s and brightne contrasts much exceeding those of the direct observable larger granules.

523.7

5438. New remarks on the hydrodynamical inte pretation of the periodicity of the sun spots. D. RI BOUCHINSKY. *C.R. Acad. Sci., Paris*, **230**, 1019– (*March* 13, 1950) *In French.*

A theory is put forward which is based on th instability (due to non-uniform temperature distrib tion) of a liquid mass agitated by circulating motion The results are also discussed in conjunction wi similar work by C. Woronetz (Thesis, Paris, 1934). A. BE

523.75

5439. An unusually intense solar flare. R. MÜLLE Note in *Naturwissenschaften*, **37** (*No.* 6) 137 (195 *In German.*

Observations at Wendelstein in H_α of the fla of November 19, 1949, are described.

M. W. OVENDE

523.752 : 535.243

5440. Photometric measurement of chromospheric flares in calcium light. M. C. BALLARIO. *Mem. Soc. Astr. Ital.*, **21** (*No.* 1) 21–34 (1950) *In Italian.*

Photometric measurements on 19 spectroheliograms at the Arcetri solar tower give the minimum value of intensity (R) for which in the bright flocculi of Ca the presence of flares of intensity 1 may be stated in the scale to-day internationally adopted. This minimum value is computed with reference to the chromosphere's intensity in $K_{2,3}$ in a quiescent zone near the region where the flocculi have been examined. Also the limits of variation in assigning a flare to the classes 2 and 3 have been determined. Following values have been obtained: Importance (1) from $R = 3{\cdot}06$ to $R = 3{\cdot}76$; (2) from $R = 3{\cdot}80$ to $R = 4{\cdot}73$; (3) from $R = 4{\cdot}79$. The said limits are also given assuming as unit the intensity of the continuum at the centre of the sun-disc or in the zone immediately near the flare. These limits are variable according to the heliographic co-ordinates of the flares at the moment of the observation. A.

523.76

5441. Evolution of the sun accompanied by corpuscular radiation. A. G. MASEVICH. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 6) 621–30 (1949) *In Russian.*

An attempt at solving the problem of the evolution of the sun is made in accordance with the evolution hypothesis suggested by Fesenkov [Abstr. 6695 (1949)] and involving an intensive corpuscular radiation assumed to be $\propto$ the luminosity of the star. The most probable picture of a star in the main sequence is a gas sphere in equilibrium, with a convection kernel whose cross-section and mass $\simeq 1/10$ of the star's cross-section, and mass, respectively. There exists a correlation $F(M, R, L, \mu) = 0$ between the mass, radius, luminosity and molecular weight of a star. The molecular weight $\mu = 1/[2X + \frac{3}{4}Y + \frac{1}{2}(1 - X - Y)]$ where X is the percentage of H, Y that of He, and $(1 - X - Y)$ the percentage of the mixture of heavier elements. The H and He contents calculated for the sun, assuming a star model with an absorption coefficient $K = K_0\rho^{0{\cdot}75}T^{-3{\cdot}5}$, are $X \sim 50\%$ and $Y \sim 40\%$, in good agreement with spectroscopical analysis of solar atmosphere. The evolution of stars tends to increase the molecular weight of their matter. In order to ascertain in what direction the star will move along the luminosity/radius curve when ageing, three possible variants are taken into consideration: (1) the mass of the star remains practically constant, (2) the mass increases, and (3) the mass decreases. The first assumption leads to the concept of the simultaneous formation of most of the stars of the galaxy. The second variant is also dismissed as extremely improbable. The third variant includes both the loss of mass by radiation and via direct emission of matter. The relationship stipulated by Fesenkov, viz. $dM/dt = -kL$ has the following value for k for the model accepted:

$$k = \frac{1}{\alpha} \times \frac{d\Pi \ln M}{dX} = \frac{1}{\alpha} \times \frac{1}{73 - 15n}\left(\frac{16}{1+X} + \frac{1}{X} + 1{\cdot}288\mu\right)$$

where α is the packing coefficient for the He nucleus, and n the exponent in the mass-luminosity law. This stellar evolution formula is applicable to stars of main sequence in the interval between hot giants and the dwarfs of the spectral class *F–G*. F. LACHMAN

523.77

5442. On the Fraunhofer lines and their centre-limb-variation on the sun's disk. A. UNSÖLD. *Ann. Phys., Lpz.* (*Folge* 6) **3**, 125–38 (1948) *In German.*

The development of our present views as to the origin of the Fraunhofer lines is discussed. A new method is then derived to facilitate the calculation of the intensities and centre-limb-variation of faint lines, as well as of the wings of strong lines. Comparing the results with his previous method and applying them to some characteristic models of the solar atmosphere, Unsöld obtains a good agreement. Using the model calculated by B. Strömgren, he then shows in detail how the observations by Minnaert (1931), Adam (1938–40) and Redman (1943) for faint lines, and those by Houtgast (1942) for the wings of strong lines can be represented satisfactorily. The region is outlined for which the conventional assumption of parallel stratified layers is usable. The necessity of further investigations in the behaviour and pressure in the outermost layers is emphasized. A. BEER

523.77

5443. N_2O bands in the solar spectrum. R. R. MCMATH, A. K. PIERCE, O. C. MOHLER, L. GOLDBERG AND R. A. DONOVAN. Letter in *Phys. Rev.*, **78**, 65 (*April* 1, 1950).

Bands of N_2O at $2{\cdot}97\,\mu$ $(2\nu_2 + \nu_3)$, $2{\cdot}26\,\mu$ $(2\nu_3)$ and $2{\cdot}13\,\mu$ $(2\nu_1 + \nu_3)$ recorded in laboratory spectra by Plyler and Barker [*Phys. Rev.*, **38**, 1827–36 (*Nov.* 15, 1931)] have been detected in solar spectra using high-dispersion spectrometers and Cashman PbS cells. Additional weak bands not recorded by Plyler and Baker were found at $2{\cdot}16\,\mu$ and $2{\cdot}28\,\mu$ in laboratory spectra. The solar tracings show asymmetry of the lines of the $2{\cdot}13\,\mu$ band due to an overlapping weaker band which may be either isotopic or originating from an excited vibrational state. M. W. OVENDEN

523.77

5444. Fine structure of HDO near $3{\cdot}7\,\mu$ in the solar spectrum. R. M. CHAPMAN AND J. H. SHAW. Letter in *Phys. Rev.*, **78**, 71–2 (*April* 1, 1950).

523.77

5445. The $3\nu_3$-band of telluric CO_2 in the solar spectrum. L. GOLDBERG, O. C. MOHLER, A. K. PIERCE AND R. R. MCMATH. Letter in *Phys. Rev.*, **78**, 74 (*April* 1, 1950).

523.8 : 523.746 : 538.11 : 530.1

On the origin of the magnetic fields on stars and in interstellar space. *See Abstr.* 5479

523.8 : 538.12

5446. On the significance of stellar magnetic fields. H. KIENLE. Note in *Naturwissenschaften*, **37** (*No.* 6) 137–8 (1950) *In German.*

It is suggested that the observed stellar fields are the integrated effects of the fields of individual "star-spots." The sun when so observed would appear to have a general field varying between ± 10 gauss with a period of 22 years. M. W. OVENDEN

523.802

5447. The analysis of star counts in two wavelengths. Sh. T. Khabibullin. *Astr. J., USSR*, **26** (*No.* 4) 219 (1949) *In English.* Abstr. in *Astr. News Letter* [*Harvard*] (*No.* 47) (1950) *In Russian.*

It is shown that Seeliger's theorem, that it is impossible to determine from star counts the density of the stellar population without previous knowledge of the law of absorption, is true for counts in 2 wavelengths as well as for those in 1.

M. W. OVENDEN

523.802

5448. Determination of the space density of stars from photographs in two wavelengths. D. J. Martynov. *Astr. J., USSR*, **26** (*No.* 4) 221 (1949) *In Russian.* English Abstr. in *Astr. News Lett.* [*Harvard*] (*No.* 47) (1950).

The difficulty pointed out by Khabibullin [Abstr. 5447 (1950)] is overcome by assuming a distribution function $A(r) = a_0 r$, $A'(r) = a_0$, or, to a better approximation, the formulae of Paranego $A(r, b) = a_0\beta\{1 - \exp[(-r \sin b)/\beta]\}/\sin b$ and $A'(r, b) = a_0 \exp[(-r \sin b)/\beta]$, whence the two equations for $D(r)$ (one from the photographic magnitudes, the other from the photovisual magnitudes) can be solved for various values of a_0, the correct value for a_0 being that which gives two identical values for $D(r)$. M. W. OVENDEN

523.823 : 523.85

5449. Photoelectric studies. III. Color-luminosity arrays for the Coma Berenices and Ursa Major clusters. O. J. Eggen. *Astrophys. J.*, **111**, 414–25 (*March*, 1950).

523.832

5450. Radial velocities of 2111 stars. R. E. Wilson and A. H. Joy. *Astrophys. J.*, **111**, 221–61 (*March*, 1950).

523.838

5451. The rotational velocities of groups of stars, as determined from the apparent rotational velocities. A. Brown. *Astrophys. J.*, **111**, 366–74 (*March*, 1950).

523.841 : 523.87

5452. Variations in velocity and spectrum of eight N-type long-period variable stars. R. F. Sanford. *Astrophys. J.*, **111**, 270–8 (*March*, 1950).

523.841.37

5453. On the displacements of lines in the spectrum of delta Cephei. W. Zonn. *Ark. Astr.*, **1**, *Paper* 11, 109–21 (1950).

523.852

5454. On the formation of galaxies. G. Krall. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **2**, 221–8 (*March*, 1947) *In Italian.*

Armellini's theory of the formation of elliptic nebulae by condensation in a rotating gas of low density is discussed and found to be consistent with the principle of adiabatic invariance. R. A. NEWING

523.852.22

5455. A survey of internal motions in the planetary nebulae. O. C. Wilson. *Astrophys. J.*, **111**, 279–305 (*March*, 1950).

523.852.3 : 523.874

5456. Determination of the absolute proper movements of stars in extragalactic nebulae. N. V. Fatchikhin. *Dokl. Akad. Nauk, SSSR*, **71** (*No* 253–6 (1950) *In Russian.*

523.854 : 535

5457. Investigation of optical absorption in galaxy from the colour excess of faint stars. E. Kharadze. *Dokl. Akad. Nauk, SSSR*, **71** (*No* 257–60 (1950) *In Russian.*

523.85

5458. The thickness of the galactic absorbing la M-T. Martel. Note in *Ann. Astrophys.*, **13**, 1 (*Jan.–March*, 1950) *In French.*

Oort's method for finding the extent of the gala absorption [*Ann. Astrophys.*, **1**, 71 (1938)] is repea using the more complete data furnished by Stebb Huffer and Whitford [Abstr. 375 (1940)], and results compared with those found otherwise by author [Abstr. 3725 (1950)]. M. W. OVEN

523

5459. An atlas of spectra of six stars of classes and N. R. F. Sanford. *Astrophys. J.*, **111**, 26 (*March*, 1950).

523

5460. The peculiar star HD 30353. W. P. Bid man. *Astrophys. J.*, **111**, 333–50 (*March*, 1950).

The spectrum is shown to possess characteris similar to those of the well-known peculiar sta Sagittarii, but at a somewhat lower temperatu The spectral type of HD 30353 may be estimated near *A*5, but the hydrogen lines are extremely we and there is no measurable Balmer discontinu The spectrum is a most complex one, containing v strong lines of the ionized metals, as well as ma additional lines which do not appear strongly normal stellar spectra. The Hα line appears emission. A table of wavelengths covering region $\lambda\lambda$3517–6678 Å is contained in the pap The radial velocity is variable in a period of order of 1 year. The value of K appears to be least 50 km/s. The paper closes with some gene remarks concerning the stars whose spectra g evidence of low hydrogen content.

523.87 : 523.1

5461. The interstellar λ4430 band. J. L. Gree stein and L. H. Aller. *Astrophys. J.*, **111**, 328– (*March*, 1950).

Measured equivalent widths of the interstell λ4430 band made on spectrograms taken at t McDonald Observatory are given in Table 1. T profile is found symmetric and smooth. Correlatio of λ4430 with other interstellar features are given Table 2. The band is most strongly correlated wi the interstellar λ6284, fairly well correlated wi interstellar reddening, and may be well correlat with interstellar polarization. Diffuse absorptio bands occur in the solid and liquid states in molecul which have incomplete inner shells of electron Such substances are often paramagnetic, as in t case of iron alums and salts of the rare earths. It possible that the compounds responsible for t diffuse interstellar bands also are active in t orientation of small, elongated paramagnetic grai and thus produce the interstellar polarization.

523.877

5462. On a necessary condition for the stratification of a rotating fluid star in relative equilibrium. C. MINEO. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **1**, 21–8 (*Jan.*, 1946) *In Italian.*

The differential geometry of a family of surfaces, which for varying values of a parameter constitutes the stratification of the star, is studied. Gravitation (via a Newtonian potential), and a density function are then introduced. A condition which is necessary for the existence of stratification is then derived. This is purely geometrical. L. S. GODDARD

523.877

5463. On certain paths of stellar evolution. I. Preliminary remarks. E. SCHATZMAN. *Bull. Acad. Roy. Belg. Cl. Sci.*, **35** (*No.* 12) 1141–52 (1949) *In French.*

The possibility of evolution along the main sequence with loss of mass is investigated [see Abstr. 6695 (1949)]. Evolutionary properties of standard model stars are discussed (i) for constant mass, and (ii) for equatorial mass loss due to rapid rotation. Stars producing energy by nuclear processes are not expected to maintain the continued rotational ejection of matter on account of a rapid decrease in angular velocity. R. A. NEWING

523.877

5464. Contributions to the study of the internal structure of stars and of their stability. P. LEDOUX. *Mem. Soc. Roy. Sci. Liège*, **9** (*No.* 1) 9–294 (1949) *In French.*

The author's investigations of the dynamical stability of stars [Abstr. 1416 (1947)], of models with discontinuity of mean molecular weight [Abstr. 1712 (1947), 4416 (1949)] and of stellar pulsations [Abstr. 2459 (1946)] are here collected together and discussed in relation to general theoretical developments. There is an extensive bibliography.

R. A. NEWING

523.877

5465. Stellar evolution accompanied by corpuscular radiation, considered from the point of view of the internal constitution of the stars. A. G. MASEVICH. *Astr. J., USSR*, **26** (*No.* 4) 207 (1949) *In Russian.* English Abstr. in *Astr. News Lett.* [*Harvard*] (*No.* 47) (1950).

The influence of the relative abundances $X_{C,N}$ of C and N is discussed, and it is concluded that the luminosity L is approx. unchanged over a considerable range of values of $X_{C,N}$. From a knowledge of L, mass M and radius R, it is then possible to determine the present values of X_H and X_{He} and to compute their values at former times. With energy production by the carbon cycle, it is assumed that the empirical M–L relation is satisfied throughout evolution, M diminishing with time by some sort of corpuscular radiation. Calculations made for the Schwarzschild and Harrison solar models [Abstr. 1400 (1947) and 5218 (1949)], with $X_H + X_{He}$ independent of time and assuming $L \sim M^{10/3}$, show that $M = M_{max.}$ (when $X_{He} = 0$) $= 5$ and 8 respectively (M in solar units). From the variations of M and L with time it is concluded that Fessenkoff's relation $dM/dt =$ const. L [Abstr. 6695 (1949)] is approx. satisfied. A model with guillotine factor $\tau = 1$ gives $M_{max.} = 15$, while a progressive change in $X_H + X_{He}$ from 0·88 to 0·96 gives $M_{max.} = 3$. It is suggested that the sun may have started as an A or late B star with $M \leqslant 5$, evolution being at first rapid, but with no appreciable change in M, L and R during the last 3×10^9 years. It is stressed that rotation effects have not been considered. R. A. NEWING

523.877

5466. On the anharmonic pulsations of the standard model. C. PRASAD. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 5) 528–34 (1949).

A method of solving the equations of anharmonic pulsation by the use of Fourier series is developed. This is applied to the standard model. It is found that the first two overtones give a considerable skewness to the radial velocity curve, and the effect of the totality of overtones is discussed. It is also found that the increase in the period is slight. A.

523.877

5467. Anharmonic pulsations of the standard model: commensurable periods. C. PRASAD. *Mon. Not. Roy. Astr. Soc.*, **109** (*No.* 6) 711–19 (1949).

The equations of anharmonic pulsation are obtained for $\alpha = 0{\cdot}4$ and solved by the use of Fourier series. The skewness of the velocity curve obtained is in conformity with observation. A method is developed for obtaining solutions adjacent to the periodic solution, and the bearing of these upon observation is discussed. A.

523.877

5468. Study of the dynamical and vibrational stability of white dwarfs. E. SAUVENIER-GOFFIN. *Mem. Soc. Roy. Sci., Liège*, **10** (*No.* 1) 1–141 (1950) *In French.*

Theories of the structure of white dwarfs are reviewed, and a section on adiabatic radial oscillations (dynamical stability) repeats the results of a previous paper [Abstr. 28 (1950)] in an expanded form. The "vibrational" stability of a degenerate configuration with respect to slightly non-adiabatic pulsations is considered, and a condition is established analogous to Rosseland's criterion for main sequence stars. The theory applied to central-source and shell-source models, assuming energy generation $\propto \rho T^\nu$, gives stability for $\nu \leqslant 9{\cdot}5$ and $2{\cdot}6$ respectively. It is concluded that energy generation in white dwarfs is unlikely to arise from nuclear reactions.

R. A. NEWING

523.877

5469. The violet CN bands as criterions of absolute magnitudes in *G* and *K* stars. J. PLASSARD. *Ann. Astrophys.*, **13**, 1–50 (*Jan.–March*, 1950) *In French.*

523.877

5470. On the metallic-line stars. M. RUDKJÖBING. *Ann. Astrophys.*, **13**, 69–71 (*Jan.–March*, 1950).

The occurrence of both ordinary stars and the so-called metallic-line stars in the same region of the Hertzsprung–Russell diagram is explained by a structural difference in atmospheric models, in convective and radiative equilibrium respectively, counterbalancing a difference in atmospheric parameters and a corresponding difference in the masses of the stars. A.

523.877

5471. Equation of state of hydrogen, helium, and Russell mixture at high temperatures and pressures. R. E. MARSHAK, P. M. MORSE AND H. YORK. *Astrophys. J.*, **111**, 214–20 (*March*, 1950).

Several improved tables of the equation of state of a Russell mixture of elements with and without hydrogen and helium have been computed. Account has been taken of electron screening and the conversion of bound states into free states due to the proximity of neighbouring atoms at sufficiently high densities. A.

523.877

5472. Radial oscillations of the generalized Roche model. Z. KOPAL. *Astrophys. J.*, **111**, 395–407 (*March*, 1950).

Small, adiabatic radial oscillations are possible only for certain ratios of specific heats of the material constituting the composite configuration (which restricts the extent of the homogeneous core to certain fractional dimensions) and only if the amplitudes of oscillation of the core and of its envelope are such as to insure the continuity of motion across the interface. When these conditions are met, the spectrum of the eigen-frequencies is discrete. Tables summarize the characteristic ratios of specific heats, the permissible relative dimensions of the core, and the amplitude ratios appropriate for various modes of oscillation. A.

523.877

5473. Eta Carinae. I. The nebulosity. E. GAVIOLA. *Astrophys. J.*, **111**, 408–13 (*March*, 1950).

523.877

5474. Note on the effect of unequal molecular weights on the internal temperature-density distribution of a star. R. E. MARSHAK AND G. M. WING. *Astrophys. J.*, **111**, 447–8 (*March*, 1950).

523.877 : 539.153

A new stable state of the negative hydrogen ion. *See Abstr.* 6017

523.877 : 539.185

5475. On certain nuclear reactions of astrophysical importance. I. Formation of neutrons. P. DUMÉZIL-CURIEN AND E. SCHATZMAN. *Ann. Astrophys.*, 80–8 (*Jan.–March*, 1950) *In French.*

[See *Kothari, Proc. Roy. Soc.*, **A, 162,** 1937)]. Transition probabilities are calculated neutron formation from protons and electrons. variation of reaction rates with density ρ and t perature T is investigated, and, for a degene electron gas, is found to increase rapidly with ρ $\rho \sim 1{\cdot}14\times10^{7}$ g/cm³. In the non-degenerate c assuming that the neutrons react to form He, found that the rate of energy generation is > for the proton-proton reaction if $T > 5\times10^{8}$ degr R. A. NEW

522

5476. The equilibrium distribution of the lo period tides over an ocean covering the north hemisphere. M. R. REES. *Quart. J. Mech. A Math.*, **3**, 80–8 (*March*, 1950).

52

5477. On the variations in the period of Chandler motion of the pole and the rigidity of the earth. P MELCHIOR. *Bull. Acad. Roy. Belg. Cl. Sci.*, (*No.* 12) 1054–8 (1949) *In French.*

Continuing [see *Bull. Acad. Roy. Belg. Cl.* (*No.* 4) 424–38 (1949)] his analysis of the Chandler motion of the pole, the author finds in it 2 co ponents, one of period 1·183 yr and amplitude 0·16 the other of period 1·233 yr and amplitude 0·08 attributable to the crust and core respectively. T rigidities are calculated and found to agree with oth experimental values. The non-transmission of sh waves through the core might well be caused by t presence of a thin fluid layer between core and mant and it is pointed out that these waves are reflect not at the surface of the core itself, but from Dahr layer. E. M. FOURNIER D'AL

526.7 : 550.3

5478. The determination of normal weight in geodes A. JUDICE. *Geofis. Pura Appl.*, **16**, 7–12 (*Jan March*, 1950) *In French.*

Contains the development of the theory of t adoption of the ellipsoid of revolution in the gra metric method, for the determination of the earth shape.

PHYSICS 53

FUNDAMENTALS 530.1

530.1 : 538.11 : 523.746 : 523.8

5479. On the origin of the magnetic fields on stars and in interstellar space. L. BIERMANN; A. SCHLÜTER. *Z. Naturforsch.*, **5a**, 65–71 (*Feb.*, 1950) *In German.*

New mathematical considerations, on the basis of the kinetic theory of gases and the electronic theory, are put forward to prove the existence of strong magnetic fields on rotating stars, and to deduce the size of fields in interstellar space. As to the magnetic fields of sunspots, maintaining a modified Bjerknes turbulence model of the solar activity, it is pointed out that the fields of the spots will probably be fully understood as soon as their dynamics is clarifie In an appendix, A. Schlüter calculates a special mod of a non-rigidly rotating star and derives the structu of its magnetic field. A. BE

530.1

5480. The theory of the unitary field and quantu theory. G. IWATA. Letter in *J. Phys. Soc. Japan*, 21–4 (*Jan.–Feb.*, 1949) *In French.*

530.1

5481. Existence theorem for Einstein's gravitationa equations in the non analytic case. Y. FOURÈS-BRUHA *C.R. Acad. Sci., Paris*, **230**, 618–20 (*Feb.* 13, 1950) *French.*

530.12

5482. The physical content of 5-optics. Yu. B. Rumer. *J. Exp. Theor. Phys., USSR*, **20**, 199–205 (*March*, 1950) *In Russian.*

A survey of the results of the author's previous publications on action as a co-ordinate of space [Abstr. 2326, 5234 (1949)] in their physical meaning. The content of 5-optics is presented in a very clear and convincing form and the sections dealing with the geometrical sense of Planck's constant, the unified principle of conservation (combining the conservation laws of energy, momentum and charge, and based on the invariance of the Einstein group and of the group of gradient transformations) are of particular interest. Further sections are devoted to the new aspect of neutral particles, the magnetism of stars and the equivalence principle in 5 co-ordinates. The greatest simplification introduced by the new representation is that the number of fundamental particles is hereby reduced to 2 (photons or electrons), the others used at present appearing only as "heavy states" in a well defined and easily comprehended sense. B. F. KRAUS

530.12 : 530.145 : 531.19

5483. On the analogy between the postulates of statistics and relativity in the quantum theory. E. Keberle. *Helv. Phys. Acta.*, **22** (*No.* 6) 627–36 (1949) *In German.*

530.12 : 531.51

5484. On Einstein's principle of equivalence. A. Barajas. *Comisión Impulsora y Coordinadora de la Investigación Científica* (*Mexico*) *Anuaria* 1945, 25–30 (1947) *In Spanish.*

World lines of particles acted on solely by gravitational forces are considered. The principle of equivalence is used to deduce (i) the world-lines of particles subject only to gravitational forces are the paths of an affine connection, (2) the principle of equivalence is valid in Birkhoff's gravitational theory. MATHEMATICAL REVIEWS

530.12 : 531.51

5485. Lagrange form of the equations of motion in the second approximation of Einstein's theory of gravitation. I. G. Fikhtengolts. *J. Exp. Theor. Phys., USSR*, **20**, 233–42 (*March*, 1950) *In Russian.*

The equations of motion of finite masses in the 2nd approximation of Einstein's theory of gravitation are considered and the Lagrange and Hamilton functions of this approximation established. All 7 integrals analogous to the integrals of classical mechanics are obtained. The corrections of Newton's gravitation law are found which show that in the 2nd approximation the forces of interaction between mass pairs have a non-conservative character. The integrals of the equations of motion of the centre of gravity of systems of finite masses are also given, whereby the covariance of the latter equations is proved. A generalized expression of the mass of a body is presented. B. F. KRAUS

530.12 : 535.22

5486. Some observations on the relations of classical and relativistic mechanics. A. Masani. *Mem. Soc. Astr. Ital.*, **21** (*No.* 1) 71–3 (1950) *In Italian.*

Stating with accuracy an interpretative process used in connection with a formula of relativistic dynamics the impossibility of an infinite value for the velocity of light is demonstrated. A.

530.12 : 535.22

5487. Extrapolation from the Michelson–Morley experiment. H. E. Ives. *J. Opt. Soc. Amer.*, **40**, 185–91 (*April*, 1950).

The invariance with motion of the measurement of 2-way light signals in the Michelson–Morley experiment is extrapolated to 1-way measurements. The time of arrival of signals at a distant point is accepted as indeterminate, in accordance with the before-and-after characterization of Robb; but it is shown that, in spite of this indeterminancy, definite expressions can be obtained for the operations involved in measuring 1-way signals. Extension of the same reasoning leads to Lorentz-type transformations expressed in terms of observable rod and clock readings, which include the self-observed velocities of moved clocks used to set the epochs of distant clocks. A.

530.12 : 537.1

5488. The external gravitational and electromagnetic fields of rotating bodies. G. L. Clark. *Proc. Roy. Soc. A*, **201**, 488–509 (*May* 23, 1950).

In previous papers [Abstr. 189 (1941), 1136 (1947)] it was shown that the loss of gravitational energy of a rotating system such as a rod may be established by considering the non-periodic terms of order $I^2\omega^5/r^3$ in the equation $G_{\mu\nu}=0$ for the external field, I being the moment of inertia in the case of a rod. The present investigation begins by calculating the terms of order $I^2\omega^6/r^2$ in the expressions for $G_{\mu\nu}$. It is found that the equation $G_{\mu\nu}=0$ has no solution. Values of the $g_{\mu\nu}$ can be determined, however, for which the material energy-tensor has the form of the Faraday–Maxwell stress-tensor due to certain periodic electromagnetic fields. In this way a link is established between periodic gravitational and electromagnetic fields, but the electromagnetic field is not uniquely determined by the analysis. Next a rotating sphere is considered. The calculation is carried out as far as terms of order $m^3\omega^2/r^7$ in the $G_{\mu\nu}$. Again it is found impossible to find a solution of the equation $G_{\mu\nu}=0$, but the "material" energy-tensor can be identified with an electromagnetic energy-tensor. In both the cases of the periodic system and of the sphere potentials are found for which the energy-tensor represents a field of the form proposed by Blackett (1947), but the investigation does not rule out the possibility that other alternative solutions may exist. The solution in the case of a "Blackett field" requires a current-charge vector inside the material with a non-zero charge, but the precise values of either the charge or current densities are determined. The solution, in fact, covers the case of a rotating charge as well as of a rotating "neutral" body. Presumably, further physical considerations must be taken into account to solve the problem completely. As the rotation of the earth produces no visible electric field, the resultant charge must be small. A.

530.12 : 538.3

5489. Relativity theory and electromagnetism. R. SOUDAN. *Arch. Sci.*, **3** (*No.* 1) 5–16 (1950) *In French.*

An analogy noted by Thirring [*Phys. Z.*, **19**, 204–5 (*May* 15, 1918)] between relativistic equations for weak gravitational fields and electromagnetic equations is rediscovered. An attempt is made to identify the latter equations with the former by assuming that the $g_{\mu\nu}$ depend on the ratio of particle charge to mass. R. A. NEWING

530.12 : 538.3 : 521.038

5490. Electromagnetism and relativity. V–VII. Terrestrial magnetism as a consequence of general relativity. J. MARIANI. *Cah. de Phys.* (*No.* 34) 1–28 (*March*, 1950) *In French.*

This paper completes the publication of results established in 1944. The new field equations [Abstr. 3756 (1949)] are here derived from a variation principle and are extended to the general case in which the ratio of proper charge density σ to proper mass density ρ is variable. It is shown that ρ must be positive, while σ can have either sign and is the sum of two parts, a Maxwellian charge, and a non-Maxwellian charge proportional to ρ. The theory applied to an electrically neutral rotating body predicts the existence of a magnetic moment $= (1/6)\sqrt{G} \times$ the angular momentum. This result is used to calculate solar and terrestrial magnetic fields. The terrestrial electric field is also discussed, and is explained in terms of an additional electric charge associated with the energy of the gravitational field. R. A. NEWING

530.14 : 531.51

5491. Foundations of the electromagnetic explanation of universal gravitation, followed by a note on the proton and the meson. H. VARCOLLIER. *Arch. Sci.*, **2** (*No.* 3) 483–512 (1949) *In French.*

From the postulate that protons generate an ellipsoidal field it is concluded that there will be a residual attraction, interpreted as gravitation, between two electrically neutral systems. R. A. NEWING

530.145

5492. A certain algebra and second quantization. J.-G. VALATIN. *C.R. Acad. Sci., Paris*, **230**, 722–4 (*Feb.* 20, 1950) *In French.*

It is pointed out that simplifications arise in the theory of second quantization on making use of the abstract space of antisymmetric tensors.

P. T. LANDSBERG

530.145

5493. On the quantization of the metric field and the particle-field interactions. II. Application to magnetic and nuclear fields. A. GIÃO. *C.R. Acad. Sci., Paris*, **230**, 434–6 (*Jan.* 30, 1950) *In French.*

See Abstr. 3764 (1950). Expressions are obtained for the energies of static particle fields. R. A. NEWING

530.145

5494. On the method of third quantization. II. Y. NAMBU. *Progr. Theor. Phys.*, **4**, 399–411 (*Oct.–Dec.*, 1949).

Continuation of Abstr. 1471 (1950). The wave-equation in the new formulation is calculated in detail; and the first-order corrections to the various operators are evaluated, and agree with those obta in the usual second quantization. Some remarks added on the application of the method to the sin problem of the harmonic oscillator, and its rela to the theory of Yukawa [Abstr. 1456 (1950)].

G. J. KY

530.145 : 5

5495. Running electromagnetic multipole wa and a new method of field quantization. G. MOLI *Ann. Phys., Lpz.*, **6**, 146–62 (1949) *In German.*

Using Maxwell's equations for the complex fi vectors $H \pm iE$, 3 matrices of 3 rows and colu in form similar to the angular momentum matri are introduced. Operators corresponding to energy, momentum, angular momentum, etc., o photon are given, and the formalism leads to introduction of a "polarization variable." With aid a modification of the usual quantization r for the electromagnetic field is proposed and leads to a finite field energy. P. T. LANDSB

530.

5496. A divergence-free field theory. K. SAWA *Progr. Theor. Phys.*, **4**, 412–19 (*Oct.–Dec.*, 1949).

This is a generalization of a suggestion by Fe mann that field commutators be chosen so that reaction effects vanish in the limit of infinite parti mass. This is done so that the self-energies of electron in an electromagnetic or scalar meson fi are now finite. G. J. KYN

530.1

5497. On a system of fields free of the divergen of mass-renormalization type. J. RAYSKI AND RZEWUSKI. *Helv. Phys. Acta*, **23** (*No.* 3) 287- (1950).

Theoretical demonstration that the divergences o neutral scalar meson field may be cancelled, on ma renormalization, by suitable interactions with charg fermion and charged boson fields. No physi realization of this system is known. J. R. MADD

530.1

5498. Commutator equations for fields derived fr a variation principle. C. GREGORY. Letter in *Phy Rev.*, **78**, 67–8 (*April* 1, 1950).

530.1

5499. Some general formulae relating to vacuu polarization. H. UMEZAWA AND R. KAWABE. *Prog Theor. Phys.*, **4**, 423–42 (*Oct.–Dec.*, 1949).

A development of the "*C*-meson" theory due Sakata and Hara [Abstr. 1477 (1950)]. Usi perturbation theory in the interaction representatio an expression for the current induced by a curre which exists in vacuum is obtained. The formul are general in the sense that no specific type charged particle is assumed [see following Abstr The contributions of vacuum polarization to elast and Compton scattering are also considered.

P. T. LANDSBER

530.1

5500. Vacuum polarization due to various charge particles. H. UMEZAWA AND R. KAWABE. *Prog Theor. Phys.*, **4**, 443–60 (*Oct.–Dec.*, 1949).

The formulae of a previous paper [precedi Abstr.] are applied to the vacuum polarization due t

charged scalar, vector and Fermi particles. This involves the calculation of appropriate charge renormalization terms. The condition for a finite photon self-energy by using mixed scalar, vector and spinor fields is also investigated. P. T. LANDSBERG

530.145

5501. Note on the vacuum polarization. G. TAKEDA. Letter in *Progr. Theor. Phys.*, **4**, 573–5 (*Oct.–Dec.*, 1949).

530.145

5502. On the retarded electromagnetic interaction of two Dirac–Pauli particles. A. BORSELLINO AND P. CALDIROLA. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **1**, 969–73 (*Sept.*, 1946) *In Italian.*

Dirac–Pauli particles are described by the generalized Dirac equation

$$\left[\gamma_\mu \pi_\mu - iMc - \frac{1}{c}\lambda \gamma^\mu \gamma^\nu F_{\mu\nu}\right]_{\mu>\nu} \psi = 0$$

where λ represents an intrinsic magnetic moment and the other symbols have their usual meaning. The interaction of two of these particles is calculated by standard methods: the matrix element is a generalization of that holding for electrons, and includes terms in λ_1, λ_2 and $\lambda_1 \lambda_2$. For neutral particles the only interaction is that due to the term in $\lambda_1 \lambda_2$.

L. PINCHERLE

530.145

5503. The radiative collisions of positrons and electrons. J. KATZENSTEIN. *Phys. Rev.*, **78**, 161–9 (*April* 15, 1950).

The general matrix elements for the collision of 2 electrons (*e-e* case) or a positron and an electron (*p-e* case) accompanied by the emission of a quantum of radiation are formulated. It is expected that the two cross-sections will differ considerably both because of the existence of a dipole for the *p-e* case, and because of the essentially different nature of the exchange phenomenon in the *p-e* case arising there from the possibility of virtual pair creation or annihilation rather than the indistinguishability of the particles. Two cases are calculated in detail; the non-relativistic limit and the extreme relativistic limit in which the quantum energy is restricted to $\leqslant E^{\frac{1}{2}}$ in the laboratory system. In the former case the cross-section for the *e-e* case is found to vanish if the momentum of the quantum is neglected, while the *p-e* cross-section is comparable to that for the "bremsstrahlung" process. In the latter case the cross-sections of the 2 cases are of the same order of magnitude, the *e-e* cross-section being greater because of the exchange terms, those of the *p-e* case being negligible in all of the cases considered. A.

530.145

5504. Radiative electron interaction. I. H. J. GROENEWOLD. *Proc. K. Ned. Acad. Wet.*, **53** (*No.* 4) 414–31 (1950).

Application of a previous formulation [Abstr. 2966 (1949)] of quantum electrodynamics in which the electromagnetic field is not explicit, to low-order radiation processes. The interaction of large systems of electrons is considered. Diagrams similar to those of Dyson arise and are interpreted in this new formulation. J. R. MADDOX

530.145 : 539.151

5505. On the reaction of the radiation field. M. SASAKI AND R. SUZUKI. *Progr. Theor. Phys.*, **4**, 485–91 (*Oct.–Dec.*, 1949).

The Lamb shift is calculated as if the electron were a charged scalar particle. The self-energy term is more strongly divergent than for a Dirac particle, but in the level shift the linearly divergent terms cancel leaving a logarithmic term identical with that for the Dirac electron, and a slightly different finite term. The shift is 967 Mc/s as opposed to 984 Mc/s for the electron if the spin corrections are not included.

G. J. KYNCH

530.145

5506. On the method of relativistic cut-off. G. WATAGHIN. Letter in *Nuovo Cim.*, **7**, 166–7 (*March*, 1950) *In Italian.*

It is suggested, from a study of experimental data and of the convergence properties of some theoretical results, that the cut-off operator suitable for the meson field is $[l^2 \Box + 1]^{-2}$, l being a universal length. With this choice the cross-section for the impact of two nucleons becomes almost independent of energy and is equal to about 0·4 the geometrical cross-section. L. PINCHERLE

530.145

5507. A lower bound on the range of neutron-proton interaction. A. A. BROYLES AND B. KIVEL. Letter in *Phys. Rev.*, **77**, 839 (*March* 15, 1950).

530.145 : 537.534.74

5508. Analysis of proton-proton scattering by means of the f function. G. BREIT AND R. D. HATCHER. *Phys. Rev.*, **78**, 110–14 (*April* 15, 1950).

The approximately linear relationship between the f function and the energy, E, is discussed by elementary methods. Formulae for the comparison of derivatives of f with respect to E are given for potentials of different shapes. The comparison of potentials is reduced to that of wave functions at a standard energy. A discussion of the relation between the meson mass corresponding to experiments on p–p scattering and the mass of the π-meson is included. The variation in the comparison owing to lack of reproduction of the curvature of the (f, E) plot is estimated and the uncertainties caused by relativistic corrections as well as modifications of the Yukawa potential at distances of the order of the Compton wavelength for the proton are considered. A.

530.145 : 539.152.1

5509. On the charge independence of nuclear forces. J. SCHWINGER. *Phys. Rev.*, **78**, 135–9 (*April* 15, 1950).

It is shown that the small difference between the n–p and p–p interactions in the ^1S state can be accounted for by magnetic forces, provided the nuclear interaction is described by the Yukawa potential. A variational principle is used to facilitate the comparison of the interactions, and for the determination of the effect of magnetic forces. A short discussion of variational principles is presented in the appendix. A.

530.145

5510. Relativistic nuclear force. T. TOYODA. Letter in *Phys. Rev.*, **77**, 853 (*March* 15, 1950).

The solution of the Klein–Gordon equation for a

pseudoscalar meson field with pseudoscalar coupling is outlined when retardation is taken into account to 1st order. The resulting proton-neutron force is worked out (in analogy with the Møller force between 2 electrons). Besides the ordinary Yukawa potential there appear 7 additional terms (some are velocity dependent). The strongest divergence at the origin is $\sim 1/r$ and the weakest convergence at infinity (important in quadrupole moment calculations) is $\sim e^{-r}$. W. J. SWIATECKI

530.145

5511. *S*-matrix n non-local field theory. H. YUKAWA. Letter in *Phys. Rev.*, **77**, 849–50 (*March* 15, 1950).

530.145

5512. The problem of the reaction of the eigen-field of a charged particle. E. S. FRADKIN. *J. Exp. Theor. Phys., USSR*, **20**, 211–17 (*March*, 1950) *In Russian.*

The suggestion of Bohm and Weinstein [Abstr. 1319 (1949)] and Shott [*Phil. Mag.*, **15**, 752 (1932)] of a possible retroaction of the eigen-field of a charged particle is investigated, more particularly in the form of possible oscillations of the particle under the influence of the eigen-field alone. On principle, this would not contradict the non-relativistic approximate model of the eigen-field generally accepted. An investigation of the more general question of the general solution of the equation of motion of the particle without external field is impossible owing to the infinite series character of the approximation. That is why the investigation can only be carried out by verification of the possibility of oscillations without external field and/or finding a suitable form of the equation of movement of the particle and solving it. This is done in the paper, with the result that the impossibility of such oscillations is proved.

B. F. KRAUS

530.145

5513. On the magnetic moment of nucleon. K. SAWADA. *Progr. Theor. Phys.*, **4**, 532–42 (*Oct.–Dec.*, 1949). See Abstr. 1474 (1950).

530.145

5514. The nucleon magnetic moment in meson pair theories. J. L. LOPES. *Phys. Rev.*, **78**, 36–9 (*April* 1, 1950).

The contribution to the nucleon magnetic moment from an interaction of the nucleon with a spinor or scalar meson pair field is calculated. In both cases it is found to be logarithmically divergent. A.

530.145 : 539.18

5515. On the gauge-difficulty in the γ-decay of the neutral scalar meson. D. ITÔ AND T. MIYAZIMA. *Progr. Theor. Phys.*, **4**, 492–5 (*Oct.–Dec.*, 1949).

The decay is calculated assuming that it occurs through both the nucleon field and a real charged scalar field, of equal masses and with equal coupling constants. A gauge invariant matrix element is obtained in 2nd order, as by the regulator procedure.

G. J. KYNCH

530.145

5516. Interaction between four half-spin particles and the decay of the μ-meson. L. MICHEL. *Proc. Phys. Soc., Lond. A*, **63**, 514–31 (*May*, 1950).

The general direct coupling between four fermions is studied. It is a linear combination of the invariants used in β-decay theory. Altering the o of the particles in the Hamiltonian changes only coefficients of the linear combination. The forma of charge conjugation is used with the ordinary the or the Majorana abbreviated theory for neu particles. This is applied to the study of the deca the μ-meson into an electron and two neutrinos.

530.145 : 539

5517. On the decay of heavy mesons. I. S. OZA S. ÔNEDA AND S. SASAKI. *Progr. Theor. Phys.*, 524–31 (*Oct.–Dec.*, 1949).

The precise way of applying the Pauli regula procedure is discussed at length for problems w pseudoscalar mesons and ps.-scalar and ps.-vec coupling. The formal equivalence of these t interactions can only be verified in special calculati after regulation. G. J. KYN

530.145 : 539

5518. Are mesons elementary particles? H. MOSELEY AND N. ROSEN. Letter in *Phys. Rev.*, **78**, (*April* 1, 1950).

Fermi and Yang investigated recently [Abs 2686 (1950)] the possibility of considering the π-mes as a composite particle formed by a nucleon and antinucleon. Authors find that the $^1S_0$ state has be excluded because its energy tends to zero rath than to $2\,Mc^2$ as the interaction goes to zero. On t other hand, the $^3P_0$ state appears to give an acceptat solution. These results apply to the case of the vect interaction adopted by Fermi and Yang. In the ca of tensor type of interaction it is found that ^{1}, solutions exist for one sign of the interaction par meter and $^3P_0$ solutions for the other. Since it wou follow that not only a proton and an antineutron b also a proton and a neutron would form composi particles, it appears that this type of interaction mu be discarded.

530.145 : 513.7

5519. On [a] transformation in quantum mechanic E. M. BRUINS. *Proc. K. Ned. Akad. Wet.*, **53** (*No.* 4 440–5 (1950).

A generalization of Dirac's relativistic wave equa tion to a projective space is proposed, and it is show how co-ordinate transformations fit into this scheme.

P. T. LANDSBER

530.145 : 538.

5520. On the meson fields associated with th electron in the new theory of the subtraction field L. DE BROGLIE AND R. REULOS. *C.R. Acad. Sci. Paris*, **230**, 1009–10 (*March* 13, 1950) *In French.*

A subtraction theory of the electronic interaction [Abstr. 2920 (1950)] is generalized so that there are several subsidiary meson fields, whose charges are integral multiples of the electronic charge.

G. J. KYNCH

530.145 : 538.3

5521. Quantum electrodynamics: the self-energy problem. H. S. SNYDER. *Phys. Rev.*, **78**, 98–103 (*April* 15, 1950).

In this paper it will be shown that the limiting processes by means of which the integrals of the Hamiltonian of the interacting electron-positron field with the electromagnetic field are defined, may be

carried out so that the self-energies of the electrons and photons are zero. A.

530.145 : 538.3

5522. On the role of the subsidiary condition in quantum electrodynamics. F. COESTER AND J. M. JAUCH. *Phys. Rev.*, **78**, 149–56 (*April* 15, 1950).

The *S*-matrix in quantum electrodynamics may be calculated alternatively from the Hamiltonian density $-j^{\mu}(x)A_{\mu}(x)$ and a Hamiltonian in which the coulomb interaction of the charges and the interaction of the currents with the transverse field are separated. Both procedures are equivalent. Care must be taken, however, to define correctly the initial states, in particular the vacuum state. The definition of the vacuum state in both representations is discussed and the equivalence of the corresponding *S*-matrices is proven. A.

530.145

5523. The difference between particles and anti-particles subject to Dirac's equation. M. MARKOV. Letter in *J. Exp. Theor. Phys., USSR*, **20**, 286–8 (*March*, 1950) *In Russian.*

An analysis of the behaviour of pairs of different composition, neutron-antineutron, nucleon-anti-nucleon, tensor and pseudo-scalar variants of forces, scalar and pseudo-vectorial interaction according to Dirac's theory; e.g. in the annihilation of slow nucleons, in which it is shown that, apart from the differentiation itself being possible only through the particular field, all theoretical and practical consequences are also defined by the latter. B. F. KRAUS

530.145 : 539.18

5524. Processes between light particles according to the Dirac theory. B. KOCKEL. *Ann. Phys., Lpz.* (*Folge* 6) **4** (*No.* 6) 279–302 (1949) *In German.*

Changes of state of electrons, which take place under emission or absorption of light without participation of heavy particles, are examined. Probabilities for the simplest of such processes as Compton effect or pair production are recalculated in a uniform manner. Processes of higher order cannot occur in which more than 1 electron changes its state under absorption or emission of any number of light quanta. Higher processes in which only 1 electron changes state under participation of at least 2 light quanta occur. The probability of a higher order process, destruction of a pair under formation of 3 light quanta, is discussed. Such "triple" scattering reaches the same probability as "double" scattering only at very high energies. At these energies "quadruple" and higher scattering is equally likely; hence no meaning attaches then to the classification of processes according to the number of emitted light quanta nor to the corresponding perturbation methods used.

J. JACOBS

530.145

5525. On the possibility of a complex structure for particles of spin 1. L. DE BROGLIE AND M.-A. TONNELAT. *C.R. Acad. Sci., Paris*, **230**, 1329–32 (*April* 3, 1950) *In French.* **Additional remarks on the complex structure of particles of spin 1.** L. DE BROGLIE. *Ibid.*, 1434–7 (*April* 17, 1950) *In French.*

The equations for a particle consisting of 2 particles of spin $\frac{1}{2}$ can be written so as to describe a particle in a pseudoscalar (spin 0) state and a vector state (spin 1). The second note describes details of the theory of such a particle. G. J. KYNCH

530.145

5526. On the Dirac theory of spin 1/2 particles and its non-relativistic limit. L. L. FOLDY AND S. A. WOUTHUYSEN. *Phys. Rev.*, **78**, 29–36 (*April* 1, 1950).

By a canonical transformation on the Dirac Hamiltonian for a free particle, a representation of the Dirac theory is obtained in which positive and negative energy states are separately represented by two-component wave functions. Playing an important role in the new representation are new operators for position and spin of the particle which are physically distinct from these operators in the conventional representation. The components of the time derivative of the new position operator all commute and have for eigenvalues all values between $-c$ and c. The new spin operator is a constant of the motion unlike the spin operator in the conventional representation. By a comparison of the new Hamiltonian with the non-relativistic Pauli–Hamiltonian for particles of spin $\frac{1}{2}$, one finds that it is these new operators rather than the conventional ones which pass over into the position and spin operators in the Pauli theory in the non-relativistic limit. The transformation of the new representation is also made in the case of interaction of the particle with an external electromagnetic field. In this way the proper non-relativistic Hamiltonian (essentially the Pauli–Hamiltonian) is obtained in the non-relativistic limit. The same methods may be applied to a Dirac particle interacting with any type of external field (various meson fields, for example) and this allows one to find the proper non-relativistic Hamiltonian in each such case. Some light is cast on the question of why a Dirac electron shows some properties characteristic of a particle of finite extension by an examination of the relationship between the new and the conventional position operators. A.

530.145

5527. The self-energy of a Dirac particle, and its relativistic covariance. R. KAWABE AND H. UMEZAWA. *Progr. Theor. Phys.*, **4**, 461–7 (*Oct.–Dec.*, 1949).

The relativistically invariant cut-off procedure developed by the authors in a previous paper [Abstr. 4694 (1950)] is applied in a first-order perturbation calculation to determine (*a*) the self-energy of an electron, (*b*) the self-energy due to a "*C*-meson" (corresponding to the *f*-field particle of A. Pais [*Verh. K. Akad., Amsterdam*, **19** (1947)]). The result of (*a*) is partly finite and partly logarithmically divergent and is identical with the result of J. Schwinger [Abstr. 6751 (1949)]. The result of (*b*) agrees with Pais's calculation. As in Pais's paper, a suitable combination of (*a*) and (*b*) gives a finite self-energy.

W. J. SWIATECKI

530.145

5528. The charge-transforms of operators in Dirac's electron theory. J.-G. VALATIN. *C.R. Acad. Sci., Paris*, **230**, 822–3 (*Feb.* 27, 1950) *In French.*

The charge-transform of an operator A in Dirac's electron theory was defined by Belinfante [*Physica*, **6**, 849–69 (*Oct.*, 1939)] as the operator $u^{-1}A^{*}u = \bar{A}$ obtained from the complex conjugate operator by a

certain unitary transformation, u depends on the matrix representation of the Dirac matrices. It is shown that all operators A decompose into two parts such that $A = A_1 + A_2$, $\bar{A}_1 = A_1$, $\bar{A}_2 = -A_2$. Further mathematical formulae are deduced from this result. P. T. LANDSBERG

530.145 : 539.18

5529. On the theory of particles of spin 1/2. J. SERPE. *Bull. Soc. Roy. Sci., Liège*, **18**, 266–71 (*June–July*, 1949) *In French.*

Some properties of such particles, described by a Dirac equation modified by E. Majorana [*Nuovo Cim.*, **14**, 171 (1937)] and having neither charge nor magnetic moment, are studied with particular reference to the possibility of a hole theory and possible interactions with meson fields. T. Okayama [Abstr. 1700 (1949)]. W. J. SWIATECKI

530.145

5530. Treatment of the oscillator and of the Dirac equations. A new method of formulating and solving wave-mechanical problems. III. H. KALLMANN AND M. PÄSLER. *Ann. Phys., Lpz.* (*Folge* 6) **4** (*No.* 1–2) 46–57 (1948) *In German.*

As in previous work [Abstr. 54, 55 (1949) and 4713 (1950)] the problems are treated with the aid of the Laplace transform. The wave equation for the one-dimensional harmonic oscillator is discussed in the form $4xy'' + 2y' + (\alpha - x)y = 0$ (α constant, x independent variable). The Dirac equations for the radial parts of the wave-functions are considered for a central field. They are solved after having been expressed as (a, b, c, d, e, f constants, and independent variable) $R_1' + aR_2' = bR_1 + cR_2$, $rR_2 + dR_2 = erR_1 + fR_2$. Known results are obtained, but the authors consider that their treatment is simpler than the usual one. P. T. LANDSBERG

530.145 : 539.153.4

5531. On the upper and lower bounds of eigenvalues. T. KATO. *J. Phys. Soc. Japan*, **4**, 334–9 (*July–Dec.*, 1949).

The Ritz–Temple formula is extended and applied to the eigenvalue problem: $d^2u/dx^2 + (\lambda - x^4)u = 0$, where $-\infty < x < \infty$. A further extension is made to cover the case of degenerate eigenvalues which are not necessarily semi-bounded. The paper is introductory, and the results are to be used in a later paper in a rigorous discussion of perturbation methods for calculating eigenvalues approximately. L. S. GODDARD

530.145 : 517.65

5532. Treatment of the space rotator by the Laplace transformation. M. PÄSLER. *Ann. Phys., Lpz.*, **6**, 365–74 (1949) *In German.*

The appropriate Schrödinger equation is solved by a Laplace transform method. Two cases arise and each is discussed. The eigenvalues and eigenfunctions are studied with the aid of various series.

L. S. GODDARD

530.145

5533. On eigenvalues of [an] incompletely reducible matrix. S. SUEOKA. *J. Phys. Soc. Japan*, **4**, 361–2 (*July–Dec.*, 1949).

The problem discussed arises in quantum-mechanical perturbation theory as applied, for instance, to atomic spectra. The Hamiltonian is written as a hypermatrix of 2 rows and columns; a unitary transformation is applied to it, so as diagonalize the submatrices of the main diagonal. Hence, subject to certain assumptions, formulae the eigenvalues of the Hamiltonian are obtain The method is claimed to be simpler than the u one. P. T. LANDSB

530.

5534. On the area bounded by an arc of a curv the Brownian movement in a plane, and its ch P. LEVY. *C.R. Acad. Sci., Paris*, **230**, 432–4 (*Jan.* 1950) *In French.*

The distribution function for the area is fou If the arc is defined by a parameter t such t $0 \leqslant t - t_0 \leqslant T$, it is shown that the characteri function is $1/\cosh(Tz/2)$. Various generalizations this are given. L. S. GODDA

530.

5535. Recurrence times. M. S. BARTLETT. Lette *Nature, Lond.*, **165**, 727–8 (*May* 6, 1950).

Chandrasekhar's definition [Abstr. 2109 (1943)] Smoluchowski's recurrence time, θ, of a state fluctuation is corrected and a method of calculati its distribution indicated. J. R. MADD

530.1

5536. Thomas–Fermi–Dirac equation for not co pletely degenerate electron gases. I. YOKOTA. *J. Ph Soc. Japan*, **4** (*No.* 2) 82–5 (*March–April*, 1949).

The Thomas–Fermi method is generalized to ta into account the effects of temperature and exchan energy on the electron distribution. The fir equation obtained agrees with the Thomas–Ferr equation at absolute zero. T. C. TO

530.162 : 531.

5537. On the modification of Boltzmann's equatio N. TAKETA. *J. Phys. Soc. Japan*, **4**, 357–8 (*July–Dec* 1949).

Boltzmann's equation state for a general distrib tion function is shown to be equivalent to a certa integral equation. P. T. LANDSBER

GENERAL MECHANICS . MECHANICS O SOLIDS 531

531.225 : 531.25

5538. The uniform torsion of an incomplete tor W. FREIBERGER. *Aust. J. Sci. Res. A*, **53**, 354–7 (*Sept.*, 1949).

A stress system is determined which gives as th resultant over any terminal cross-section a single forc acting along the axis of the tore. This will yield close approximation to the stresses in a helical spring of small pitch. The method used is that of finding a stress function analogous to the ordinary torsion function subject to a certain boundary condition and the problem is solved in toroidal harmonics. The stresses and resultant force are evaluated in terms of the dimensions of the tore and compared with the results of known approximate theories. A

531.252

5539. Upper and lower bounds for the solutions of roblems in elasticity. J. L. SYNGE. *Proc. Roy. Irish lcad.*, **53A**, 41–64 (*Feb.*, 1950).

The Prager–Synge (hypercircle) method of bounding olutions is applied to the equilibrium of a homo- eneous isotropic elastic body. Upper and lower ounds on the displacement, and on the dilatation, t an internal point are found in the case when surface isplacements are given. Bounds on the stresses at n internal point are found when surface stresses are pecified. J. G. OLDROYD

531.35 : 550.3

5540. Features of rocket kinematics in geodetic and eophysical problems. A. BERROTH. *Geofis. Pura ppl.*, **16**, 1–6 (*Jan.–March*, 1950) *In German.*

The best geometrical conditions for observation of ertically and horizontally moving rockets are nvestigated with reference to geodetic and geo- hysical applications. Various stationary conditions re derived.

MECHANICAL MEASUREMENTS 531.7

531.7

5541. High resolution recording with soot. K. R. ELDREDGE. *Rev. Sci. Instrum.*, **21**, 199–202 (*March*, 1950).

The treatment of a soot coating with a hydrocarbon olvent compacts the coat so that fine lines may be drawn in it with little force. The line resolution available is somewhat better than that of ordinary photographic films. Enlargements up to 50× the size of the original record may be usefully employed. A.

531.714.7 : 621.317.39.082.743

5542. Measurement of very small movements by means of an inductive pick-up. F. STEJSKAL. *Elektrotech. Z.* [*ETZ*] **71**, 115–16 (*March* 1, 1950) *In German.*

531.717 : 535.417

5543. Accurate thickness measurements with a Fabry–Perot interferometer. L. G. SCHULZ. Letter in *J. Opt. Soc. Amer.*, **40**, 177–8 (*March*, 1950).

531.78

5544. A photoelastic dynamometer for rapidly varying forces. E. OROWAN, F. H. SCOTT AND C. L. SMITH. *J. Sci. Instrum.*, **27**, 118–22 (*May*, 1950).

The instrument consists of a glass slab upon which the force acts, placed between crossed polarizers; the intensity of the transmitted light is a measure of the force. It is indicated by a vacuum photocell working on an amplifier and a c.r.o. The arrangement has been used for recording the variation of pressure over the area of contact in rolling mill research. Compared with piezoelectric methods, it has the advantages of stability and of applicability to moving components without using slip-rings. A.

531.78 : 621.317.39

5545. The dynamic vibration meter, theory and application of a new electrical instrument for the measurement of mechanical quantities. S. DREYFUS-GRAF. *Schweiz. Arch. angew. Wiss. Tech.*, **15**, 338–43 (*Nov.*, 1949) *In French.*

The instrument of cylindrical form consists of a transformer supplying a moving-coil generating unit coupled elastically with a similar unit connected mechanically with the output rod. It is connected also via rectifiers with a microammeter which indicates the magnitude of the vibration produced in any specified object. The theory of the apparatus is given which, it is claimed, can be employed to determine the elastic constants of a spring built in at one end, the strength of the embedment of a human tooth, the quality of the mounting of a precious stone, etc. The instrument weighs ~ 2 lb. A. C. WHIFFIN (R)

531.787

5546. A simple recording manometer. F. P. PRICE AND P. D. ZEMANY. Letter in *Rev. Sci. Instrum.*, **21**, 261 (*March*, 1950).

531.791 : 621.318.572 : 621.395.625.3

5547. Counting of pulses recorded on a steel [magnetic] tape. T. FRANZINI AND L. MUSUMECI. Letter in *Nuovo Cim.*, **7**, 159–60 (*March*, 1950) *In Italian.*

Pulses are recorded with the tape moving with velocity V_1. When the pulses are counted the velocity is V_2. Experiments were carried out for $V_1 = 10\,V_2$. For a given percentage loss of pulses, the highest frequency which it is possible to record is then 10× the normal one of the counting apparatus. L. PINCHERLE

MECHANICS OF FLUIDS 532

532.12

5548. On the relation between compressibility and molal volume of organic liquids. Y. WADA. *J. Phys. Soc. Japan*, **4**, 280–3 (*July–Dec.*, 1949).

532.122

5549. A note on the adiabatic and apparent molar compressibilities of alkali halides. B. KRISHNAMURTY. *Curr. Sci.*, **19**, 87–8 (*March*, 1950).

532.122 : 532.13 : 532.61

5550. A note on the compressibility, viscosity and surface tension of aqueous solutions of alkali halides. B. KRISHNAMURTY. *Curr. Sci.*, **19**, 87 (*March*, 1950).

532.123

5551. Mechanism of the Weissenberg effect. I. BRAUN, H. FREY AND M. REINER. Letter in *Research, Lond.*, **3**, 243–4 (*May*, 1950).

Experiments with 7 to 12% rubber-toluene solutions suggest that the Weissenberg effect should be attributed to liquid elasticity, rather than to non-Newtonian viscosity, in this case. The liquid is sheared between a rotating lower disc and a stationary upper disc, constrained by a torsion wire. The liquid rises in a central tube fitted to the upper disc (the Weissenberg effect) to a height which gradually falls off to zero while the torque on the disc remains unchanged. If the liquid is allowed to rest, the effect can be reproduced. J. G. OLDROYD

532.13 : 539.374 : 532.7

Viscous flow on the crystallite theory. *See Abstr.* 5577

532.13 : 541.64

5552. Viscosimetric properties of solutions of high polymers. G. M. GUZMÁN. *Rev. Cienc. Apl.*, **4**, 29–43 (*Jan.–Feb.*, 1950) *In Spanish.*

After some considerations and definitions of a general character with regard to viscosity the principal methods are explained for its determination in pure liquids as well as in diluted solutions of polymers. Various types of viscosimeters are described, e.g. those with capillary tube, with short tube, with falling globules and the rotational type. The concepts of specific, reduced and intrinsic viscosity are discussed, the latter being especially important for the study of polymeric substances as it is directly related to the individual characteristics of the molecules of the solution and the interaction between solute and solvent. The viscosity of polymer solution especially as regards the relation with the shape of the dissolved particles, the effect of the solvent, of temperature, of concentration and of molecular weight are studied. Bibliography. R. NEUMANN

532.133 : 539.501

The second viscosity coefficient in rheological systems. *See Abstr.* 6106

532.137

5553. A cone and plate viscometer. R. S. HIGGINBOTHAM. *J. Sci. Instrum.*, **27**, 139–41 (*May*, 1950).

A simple viscometer has been devised to determine the flow curves of anomalous fluids over a wide range of rates of shear. It is easy to fill and clean and has proved particularly useful for measurements at rates of shear of 10 000 sec^{-1} and upwards. A.

532.5 : 534.321.9

On the forces producing the ultrasonic wind. *See Abstr.* 5637

532.516

5554. A contribution to the hydrodynamics of lubrication. G. H. WANNIER. *Quart. Appl. Math.*, **8**, 1–32 (*April*, 1950).

532.516

5555. Note on the kinematics of plane viscous motion. J. L. SYNGE. Note in *Quart. Appl. Math.*, **8**, 107–8 (*April*, 1950).

532.517.4

5556. Anisotropy of the spectrum of turbulence at small wave-numbers. G. K. BATCHELOR AND R. W. STEWART. *Quart. J. Mech. Appl. Math.*, **3**, 1–8 (*March*, 1950).

In a previous paper it has been shown theoretically that the tendency to isotropic turbulence does not exist for the large-scale components of homogeneous turbulence. This paper provides experimental evidence that the large-scale components of turbulence behind a grid in a uniform stream are anisotropic, even though the total turbulent energy may be distributed with approximate spherical symmetry. The evidence consists (*a*) of a comparison between two different velocity correlations for large spatial intervals, in the initial period of decay, and (*b*) of measurements of the directional distribution of turbulent energy in the final period of decay when all except the large-scale components of the motion ha been greatly reduced by viscous decay.

532.51

5557. Note on the coefficient of eddy viscosity isotropic turbulence. T. D. LEE. Letter in *Phys. Re* **77**, 841–2 (*March* 15, 1950).

532.51

5558. The theory of axisymmetric turbulen S. CHANDRASEKHAR. *Philos. Trans. A* (*No.* 855) 55 77 (1950).

The present paper completes the theory of a symmetric tensors and forms to the extent that needed for the development of a theory of turbuler in which symmetry about a certain preferred directi is assumed to exist. Particular attention is given the manner in which tensors, solenoidal in one more indices, can be derived, uniquely, in a gaug invariant way, as the curl of a suitably defined sk tensor. The explicit representation of the fundamen velocity correlation tensor $(\overline{u_i u_j})$ in terms of tv defining scalars is found; and the differential equatio governing these scalars is also derived. In the theo of axisymmetric turbulence these latter equatio replace the equation of von Kármán and Howarth the theory of isotropic turbulence.

532.5

5559. The application of boundary-layer theory swirling liquid flow through a nozzle. A. M. BINN AND D. P. HARRIS. *Quart. J. Mech. Appl. Math.*, 89–106 (*March*, 1950).

532.5

5560. Some cavitation phenomena. T. S. WYLL *J. Roy. Tech. Coll., Glasgow*, **5** (*Pt I*) 6–25 (*Jan.*, 195 Cavitation was shown to occur in liquid irradiate with 3 780 c/s sound, taking the form of spheric fields of very small cavities (flattened near soli boundaries). There is evidence that the rate erosion of a metal surface at const. temp. varies wit time to some power greater than unity.

532.582

5561. The drag on a circular cylinder in a stream viscous liquid at small Reynolds numbers. S. SIDRA *Proc. Roy. Irish Acad.*, **53A**, 17–30 (*Feb.*, 1950).

532.582

5562. The flow of a viscous liquid past an ellipti cylinder. S. SIDRAK. *Proc. Roy. Irish Acad.*, **53A** 65–81 (*March*, 1950).

CAPILLARITY 532.6

532.61 : 536.

5563. On the thermodynamic relation betwee surface tension and curvature. F. O. KOENIG *J. Chem. Phys.*, **18**, 449–59 (*April*, 1950).

From the Gibbs' theory of surface tension genera equations are deduced for the change of surfac tension with curvature in the system having ar arbitrary number of components but no insolubl surface film. For the special case that the surface layer is spherical, the equations are shown to be reducible, by an appropriate choice of auxiliary

Gibbs' surfaces, to a simple form identical with that ecently found by Tolman for the system of one component. Some of the consequences of physical nterest following from the equation for the spherical urface layer are pointed out. A.

532.613.2

5564. Surfaces of solids. XIX. Molecular interaction between metals and hydrocarbons. W. D. HARKINS AND E. H. LOESER. *J. Chem. Phys.*, **18,** 556–60 (*April*, 1950).

The energy of interaction between a hydrocarbon and a metal increases rapidly in the order Cu, Ag, Pb and Fe, and with the value of P/P_0. The values of the work of adhesion W_A at 25°C for the clean metals are Cu 69, Ag 77, Pb 89, Fe 93. For the oxide-coated metals the values are only slightly higher. These increase with decrease of temperature. For *n*-hexane they are essentially the same at 0°C as for *n*-heptane at 25°C. Isotherms for *n*-heptane are given for both 25°C and 15°C. The method in general use for calculation of the work of adhesion from the adhesion tension is absurd, since for the usual case in which the liquid wets the solid the work of adhesion is given as twice the free surface energy of the liquid. Thus this states that the nature of the solid has nothing to do with the work of adhesion. A.

532.613.2

5565. Surface tensions in the system solid copper–molten lead. G. L. J. BAILEY AND H. C. WATKINS. *Proc. Phys. Soc., Lond.*, **63,** 350–7 (*May*, 1950).

A method is described by which the surface tension of surfaces occurring in the systems Cu–H or Cu–A and Cu–Pb–H or Cu–Pb–A is determined. At temperatures round 850°C the surface tension between Cu grains is 640 dyne/cm and between Cu and the equilibrium Pb–Cu liquid phase 340 dyne/cm. The surface tension of a Cu–gas surface is the same whether the gas is H or A, within the limits of precision of the experiment, and has the value 1 800 dyne/cm. When Pb vapour is present in the gas atmosphere at a partial pressure of the order of 0·1 mm Hg the surface tension of the Cu–gas surface has the much lower value of 780 dyne/cm. It is suggested that the reduction is due to the adsorption of Pb at the Cu–gas surface. The failure of the liquid phase to exhibit a contact angle of zero against solid Cu surfaces is thereby understood. A.

532.65 : 537.542

5566. Drop formation on ions in the Wilson cloud-chamber. M. POLLERMANN. *Ann. Phys., Lpz.* (*Folge* 6) **5** (*No.* 6–8) 329–48 (1950) *In German.*

The diffusion of a thin column of ionization (from a timed X-ray discharge) in an electrostatic field, applied for varying intervals during the increase of supersaturation at expansion, is used to study the variation of size of the embryo stable droplet as a function of supersaturation. The results are in agreement with the treatment of Volmer.

J. G. WILSON

532.68

5567. Liquid rise in a capillary tube. Y. IKEDA AND T. SOEYA. *J. Phys. Soc. Japan*, **4,** 306–10 (*July–Dec.*, 1949).

The theory of the motion of a liquid through a vertical capillary tube has been investigated. For tubes with small radii the equation derived by Brittin [Abstr. 1244 (1946)] is satisfactory but it does not give correct values for all the cases measured experimentally by LeGrand and Rence [Abstr. 710 (1946)]. A modified differential equation is solved and the calculations of liquid heights for given times agree with experiment to a first approximation. J. IBALL

532.69 : 531.43

5568. Sliding of liquid drops between solid surfaces. YA. I. FRENKEL AND O. A. SHPANSKAYA. *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 1) 37–8 (1950) *In Russian.*

One of a series of investigations on the behaviour of sliding drops [see Abstr. 93 (1949), 765 (1950)] of the school of Ya. Frenkel, based on the theory of the carrying along of drops by a moving plate along a fixed one at half the speed of the moving plate. The experiments with Hg drops exactly confirmed this theoretical result, when the top (glass) plate was loaded with weights up to 100 g, and in the speed range between 0·01 and 0·09 cm/sec. The weights of the drops varied from 10^{-5} to 10^{-2} g. The behaviour of the drops is similar to that of balls in a ball-bearing and corresponds to ideally frictionless rolling. The case is more complicated for vaseline or aviation oils, even outwardly, as the ellipsoidal form of the drops (only slightly indicated for Hg) becomes more marked, and the ellipsoids lie with their long axis perpendicular to the direction of the movement. Yet the CG of the drop still moves at half the relative speed of the plates. An important result established was that the laws of Amontons and Coulomb do not apply to "dry" friction, but only to friction between lubricated surfaces. B. F. KRAUS

532.694.1

5569. A study of foam columns from dilute solutions. F. H. CONSTABLE AND H. ERKUT. *Instanbul Univ. Fen. Fak. Mec.*, **12,** 38–52 (*Jan.*, 1947).

Details are given of an apparatus for studying the stability of foams formed from dilute solutions under standard conditions. Curves are reproduced showing the relation between stability and height of foam column for solutions of various long chain acids and alcohols. A theoretical consideration of the factors involved leads to an equation which fits the experimental foam curves. J. IBALL

532.694.1

5570. The dynamics of heptylic acid foams. F. H. CONSTABLE AND S. MERGEN. *Instanbul Univ. Fen. Fak. Mec.*, **13,** 186–96 (*July*, 1948).

Calculations are given of foam constants indicating the stability of foams formed from solutions of heptylic acid of various concentrations. The experimental data are given in an earlier paper [see Abstr. 5569 (1950)]. J. IBALL

532.696.2 : 536.62

5571. Experimental and theoretical study of the immersion of a powdered solid in a pure liquid. Construction of a micro-calorimeter. F. LAPORTE. *Ann. Phys., Paris*, **5,** 5–79 (*Jan.–Feb.*, 1950) *In French.*

A comprehensive study of the wetting of powders by pure liquids. In part one the literature on the subject is reviewed and discussed. There are 156

references. In the second part a new micro-calorimeter is described. It has a sensitivity of $1 \cdot 3 \times 10^{-5}$ °C and has been used to investigate the variation in the enthalpy of wetting by H_2O of several powders. Data are given for the effect of the condition of the surface, particularly for TiO_2. The calorimeter can be used to obtain the surface areas of non-porous powders. The final part of the paper is theoretical and a sequence of events occurring during the wetting process is proposed which is in accord with the experimental results but which departs from the generally accepted view. The main point is that the energy of the interface, solid-liquid, is a non-linear function of f where f is the fraction of unit area of the solid surface on which molecules are adsorbed. Part of the solid surface is thus "protected" from the rest of the liquid and the actual interfacial energy is less than it would be if no such "active" areas were present. ($I = E_{SL} - Af/B + f$ where I is interfacial energy, E_{SL} is max. value of I, A and B are constants, $A = 500$, $B = 0 \cdot 04$, f varies from 0 to 1.) This conception leads to explanations of the wide range of values obtained for angles of contact and assists the understanding of the phenomenon of aggregation of powders. J. IBALL

MOLECULAR THEORY OF LIQUIDS 532.7

532.7

5572. The second report on the hole theory of liquids. T. Saio and S. Onô. *J. Phys. Soc. Japan*, **4** (*No.* 2) 103–7 (*March–April*, 1949).

The hole theory of liquids developed by S. Onô [Abstr. 5971 (1949)] is extended by a theoretical evaluation of the constants involved in the theory.

T. C. TOYE

532.7

5573. Critique of the free volume theory of the liquid state. J. G. Kirkwood. *J. Chem. Phys.*, **18**, 380–2 (*March*, 1950).

A deduction of the free volume theory of the liquid state from the general principle of statistical mechanics and certain well defined approximations is undertaken. The Gibbs' configuration integral is expressed as a sum of integrals corresponding to single and multiple occupancy of the cells of a reference lattice. The integral corresponding to single occupancy is evaluated with the approximate probability density, expressed as a product of functions of the co-ordinates of individual molecules, which leads to minimum free energy under the restraints of constant temperature and volume. The minimization of the free energy gives an integral equation for the probability density within each cell of the lattice. A first approximation of the solution of this equation yields a partition function identical with that of the Lennard–Jones–Devonshire free volume theory. A.

532.7 : 530.145.1

5574. Quantum hydrodynamics. II. K. P. Gurov. *J. Exp. Theor. Phys., USSR*, **20**, 279–85 (*March*, 1950) *In Russian.*

See Abstr. 82 (1949). Derivation of the hydrodynamic equations of the 2nd approximation on basis of the kinetic equations for the distribu matrices of Bose-particles. The main interest is derivation of a formula for computing the coefficie of viscosity. The basic differences are pointed between Bogolyubov's and the author's theo in the author's opinion, Born and Green's atten to "quantize" results of classical theory are systematical. B. F. KR

532.7 : 534.32

5575. Molecular structure and ultrasonic velocity pure liquids. D. Sette. *Ric. Sci.*, **20**, 102–32 (*Fe Feb.*, 1950) *In Italian.*

Discussion of results of many workers on following subjects. Determination of molecu radius from ultrasonic velocity (assuming Van Waals' equation holds for liquids). Mathemati relations between sound velocity, density, molecu refraction, molecular structure and weight, viscos and compressibility. Extensive tables of data organic liquids and a bibliography are included.

T. S. E. THOM

532.7 : 536.4

5576. Crystallite theory of liquid. II. Solid-liq transformation. A. Ookawa. *J. Phys. Soc. Japa* **3**, 295–301 (*Sept.–Dec.*, 1948).

The crystallite theory of liquids developed in [Abstr. 6000 (1949)] is generalized to include the so state. The orientational distribution of the cc stituent crystallites being ordered below the melti point (in the solid state) and disordered above th point (in the liquid state). T. C. TO

532.7 : 539.374 : 532.

5577. Crystallite theory of liquid. III. The visco flow. A. Ookawa. *J. Phys. Soc. Japan*, **4**, 14– (*Jan.–Feb.*, 1949).

The viscous flow of a liquid and the plastic flo of a solid are considered on the basis of a propose molecular model [Abstr. 6000 (1949), 5576 (1950 of liquid and solid having a structure of a mosaic fine fragments, each of which has a perfect crystalli pattern throughout its own domain and meets well defined interfaces with its neighbours. T. C. TOY

532.7 : 541.64 : 539.1

5578. Second-order transitions and mesh distributio functions of cross-linked polystyrenes. K. Uebe reiter and G. Kanig. *J. Chem. Phys.*, **18**, 399–4 (*April*, 1950).

To the definition of the state of "liquid wit thermally fixed structure" is added that of "liqui with chemically fixed structure." Polystyrene is com bined with increasing proportions of divinylbenzene The resulting space network is represented analytical by means of the definition of a mesh width. Th second-order transition temperatures of these co polymers are determined from V–T curves. The obey a function where the constant 586[$Me \cdot T$ characterizes the stiffening of the polystyrene by th addition of divinylbenzene. These polystyrene spac networks are capable of being thermally activated up to a critical mesh width of 4 C atoms. The mesh widths are of varying sizes, the distribution is calle

he "polydictiality." The mesh distribution function can be obtained from the *V–T* curves. The capacity of the space network to be thermally activated ceases fairly suddenly. This can be understood from a function of the capacity to be activated. The experimentally determined mesh distribution functions are expressed by means of a Gauss error curve. The width of this curve, about 1·7, is in surprising agreement for all copolymers. This means that approximately 50% of all meshes lie around the average mesh width with a variation of ± 2 meshes. The method can be applied to all cross-linked high polymers. A.

532.7 : 548.5

5579. The state of matter near the melting point. G. M. BARTENEV. *J. Exp. Theor. Phys., USSR*, **20**, 218–23 (*March*, 1950) *In Russian.*

Derivation from general principles of the relation describing the liquid-crystalline state of pure substances near the melting point. Calculation shows that in a Zn-monocrystal the liquid phase within 3° of the melting point represents about 1%. The calculation was carried through for the anomalous part of the specific heat and of the volume coefficient of expansion near the melting point. Agreement with measuring results for Zn and Sn was satisfactory. The constant μ entering the formulae and determined by experiment, represents physically the critical molecular complex indicating the transition with a reduction of the number of particles in the system from the macro-characteristics of the phase to the micro-characteristics of the molecules. The dimensions of the critical molecular complex are 9 000 atoms for Zn and 1 500 for Sn. The maximum number of independent centres of fusion or crystallization which may exist simultaneously in a system, is equal to the number of the critical molecular complexes forming the system. The ideal polycrystal corresponds to the simultaneous emergence of this maximum number of centres in the liquid phase, and μ indicates the lower limit of the poly-dispersity of the poly-crystalline material. B. F. KRAUS

532.72

5580. On the anomalous thermal diffusion observed in the solution of mixed electrolytes. K. HIROTA. Letter in *J. Chem. Phys.*, **18**, 396–7 (*March*, 1950).

532.73 : 536.7 : 531.19

5581. Notes on statistical thermodynamics of solutions and gaseous mixtures. I. Y. MUTŌ. *J. Phys. Soc. Japan.*, **4**, 233–7 (*July–Dec.*, 1949).

A function called the relative free energy of solute molecules in a solvent, whose chemical potential is known, is defined thermodynamically. The statistical mechanical interpretation of this function is given. T. C. TOYE

532.73 : 536.7 : 531.19

5582. Notes on statistical thermodynamics of solutions and gaseous mixtures. II. Y. MUTŌ. *J. Phys. Soc. Japan*, **4**, 238–42 (*July–Dec.*, 1949).

The conception of semi-reducible integrals is introduced and a similar function to that defined in Paper I [see preceding Abstr.] is defined for the case of gaseous mixtures considering some of the components as solutes and the others as solvents, the relative free energy for any arbitrary part of the components being expressed in terms of these integrals. T. C. TOYE

532.73 : 536.7 : 531.19

5583. Notes on statistical thermodynamics of solutions and gaseous mixtures. III. Y. MUTŌ. *J. Phys. Soc. Japan*, **4**, 242–5 (*July–Dec.*, 1949).

A consideration of the relation between the theory given in Papers I and II and that of McMillan and Mayer [Abstr. 3000 (1945)]. T. C. TOYE

532.73 : 536.7 : 531.19

5584. The statistical thermodynamics of binary solutions. I. PRIGOGINE AND G. GARIKIAN. *Physica*, **16**, 239–48 (*March*, 1950) *In French.*

The Lennard–Jones and Devonshire model is extended to binary mixtures at temperatures far from the critical point. It becomes possible to study the influence of the following factors on the thermodynamic functions: (1) The modification with concentration of the vibration frequency of the molecules in the mean field of their neighbours; (2) the volume change with concentration. Both factors give important corrections to the usual approximation of regular solutions. A.

532.73–1

5585. On some partial molal volumes of gases in solution. J. C. GJALDBAEK AND J. H. HILDEBRAND. *J. Amer. Chem. Soc.*, **72**, 1077–8 (*March*, 1950).

Partial molal volumes of N, CH_4 and C_2H_6 have been determined in perfluoro-*n*-heptane, *n*-hexane and CS_2. Combined with the figures of Horiuti for the same gases in CCl_4 and benzene, they are seen to increase strongly with decreasing internal pressure of the solvents. A.

532.74

5586. Observations and conclusions on the structure of liquids. P. TUOMIKOSKI. *Ann. Acad. Sci. Fennicae, Ser. A*1 (*No.* 20) 3–20 (1943) *In German.*

A critical review of published work on the physical properties of liquids, with particular reference to C_6H_6 and CCl_4, in an attempt to gain a better understanding of the liquid state. The conclusion is reached that at temperatures immediately above the melting point a definite structure exists due to molecular association, the atomic structure of the molecules being very important at these temperatures. At higher temperatures, however, the molecules behave almost as isotropic particles and the structure is completely lost. T. C. TOYE

532.74

5587. A new activity relationship for binary solutions of nonelectrolytes. A. E. MARTELL. *J. Phys. Coll. Chem.*, **54**, 459–66 (*April*, 1950).

A simple relationship between activity and mole fraction for binary solutions showing small positive deviations from Raoult's law is derived and discussed. The constancy of the single parameter of this equation is demonstrated at constant temperature over the whole range of composition, and the vapour pressures predicted by the equation are compared with experimental values for a number of binary systems. A.

MECHANICS OF GASES 533

533.15 : 536.48

5588. Further experiments on the thermal diffusion of gases at low temperatures. A. VAN ITTERBEEK AND A. DE TROYER. *Physica*, **16**, 329–32 (*March*, 1950).

The separation in mixtures of H_2–N_2, D_2–N_2, H_2–A, D_2–A, He–A, etc., were measured. The well-known maximum in the curves for the change of the separation as a function of the concentration at a fixed temperature is displaced when D_2 is used instead of H_2. A.

533.16 : 533.7

5589. A viscosity equation for gas mixtures. C. R. WILKE. *J. Chem. Phys.*, **18**, 517–19 (*April*, 1950).

By application of the kinetic theory, with several simplifying assumptions, the previous equation of Buddenberg and the author has been modified to give a general equation for viscosity as a function of molecular weights and viscosities of the pure components of the mixture. Agreement of the equation with experimental data is demonstrated for a number of highly irregular binary gas systems and mixtures of 3 to 7 components. A.

533.16 : 534.21

5590. Compression- and shear-viscosity in gases. H. O. KNESER. *Ann. Phys., Lpz.*, **6**, 253–6 (1949) *In German.*

Not all the energy used in compressing a fluid is available on re-expansion. The energy absorbed may be expressed in terms of the compression viscosity ζ, the relation being similar to that between the shear-viscosity η and the energy used in shear deformation. In Stokes's theory of sound absorption the compression viscosity is neglected; its value can therefore be estimated from discrepancies between experimental observations and Stokes's theory. Available data on sound-absorption in He, Ar, H_2 and N_2 is examined from this point of view. It is found that for the monatomic gases $\zeta = 0$; for N_2 ζ is of the same order as η, while for H_2 ζ is approx. $= 60\,\eta$ at low frequencies, decreasing rapidly with increasing frequency. These results are in general agreement with predictions from kinetic theory. A. SCHOFIELD

533.21

5591. Compressibility and association in acetic acid vapours. I. Experimental determination. O. R. FOZ AND J. MORCILLO. *An. Real. Soc. Esp. Fís. y Quím.*, **45A**, 503–24 (*Nov.–Dec.*, 1949) *In Spanish.*

These were measured between 40–600 atmos. and 75–185°C by the method described earlier. [*Ibid.*, **44A**, 1263 (1948)]. The results prove that acetic acid vapours are strongly associated under these conditions. A.

533.21

5592. Compressibility and association in acetic acid vapour. II. Discussion of results. O. R. FOZ AND J. MORCILLO. *An. Real. Soc. Esp. Fís. y Quím.*, **45A**, 525–46 (*Nov.–Dec.*, 1949) *In Spanish.*

The vapours are strongly associated even for pressures below 600 atmos. and temperatures higher than 75°C. Its deviation from the behaviour of perfect gases is as large at the low pressures co sidered as it is for most of the real gases at mu higher pressures. Starting with these measures compressibility and those performed by Coolidge formic acid, equations of state for the vapours of bo acids were obtained. It has been proved that intense molecular association existing in acetic a formic acid vapours is not confined to the formati of double molecules, but that in them appear, al multiple *n*-molecules. The values corresponding the association energies of H bonds to which t association is due were calculated for the vapours both acids.

533

5593. Filament radiometric vacuum-meter. ROSTAGNI AND P. BASSI. *Atti Accad. Naz. Lin (R.C. Cl. Sci. Fis. Mat. Nat.)* **1**, 960–4 (*Sept.*, 194 *In Italian.*

See Abstr. 2783 (1947). A glass fibre of diamet 1 to 10^{-3} mm is used in place of the Al foil. T arrangement is illustrated. Curves showing t variation of angle of inclination of the tube wi pressure over the range 10^{-5} to 50 torr (mm Hg) f various currents in the heated plate and for vario thicknesses of fibre are given. The behaviour in a and H is discussed. S. WEINTRO

533.5 : 537.534.

5594. A simple mass spectrometer for leakhuntin A. STORRUSTE. *K. Norske Vidensk. Selsk. Forh.*, 2 (*No.* 6) 18–20 (1949).

A small mass spectrometer 38 mm dia. using permanent magnet with 38 mm dia. pole pieces givin 1 350 gauss is described. A hot-filament sourc giving 10 μA electron emission is used and an h of 100 V is required for H^+ ions; H^+, H_2^+ and H are well resolved. [The filament diameter is given a 0·015 mm; this is a misprint for 0·15 mm].

J. H. FREMLI

533.5

5595. On the low pressure gas flow conductance c a tube containing vapors. H. KUMAGAI, K. YAMADA K. IWANAGA AND H. SHIBATA. Note in *J. Phys Soc. Japan*, **3**, 361–2 (*Sept.–Dec.*, 1948).

Pumping speeds obtained with a Cenco rotar 2-stage pump were found to vary with pump oil used and with oil temperature. The conventional equa tions for pumping speed are modified by the addition of a term representing the resistance of oil vapours i the connecting tubes of the system. An experimenta set-up, which allows this resistance to be found, i described. There are 5 illustrations. G. WITTENBERG

533.6.011

5596. The flow of an air stream through a layer o granules. J. R. ARTHUR, J. W. LINNETT, E. J. RAYNOR AND E. P. C. SINGTON. *Trans. Faraday Soc.*, **46** 270–81 (*April*, 1950).

An investigation of the flow of an air stream through a bed of granules is described. The work may be divided into two parts: (1) an examination of the pressure drop across the bed as a function of the flow rate and the condition of the granular bed; (2) an examination of the distribution of flow rate across the bed by physical and chemical tests. A.

533.6.011 : 534.222.2

5597. On the theory of cylindrical shock wave. A. SAKURAI. *J. Phys. Soc. Japan*, **4**, 199–202 (*July–Dec.*, 1949).

An investigation of the 2-dimensional flow of a compressible fluid which moves outward from a circular source. Viscosity and thermal conductivity are taken into account in deriving the equations of flow, but in the numerical solution of these equations, a particular combination of values of viscosity and conductivity is chosen, in order to simplify the computational work. If the source is of finite dimensions the gas velocity there is sonic. Three types of flow may be distinguished: (*a*) the velocity rises monotonically to a max., while the pressure falls to zero; (*b*) the velocity falls continuously to zero, while the pressure rises to a max.; (*c*) the velocity becomes at first supersonic, then falls gradually to zero, the pressure reaching a const. value different from the max. attained in type (*b*). It is claimed that the type (*c*) flows bear a close resemblance to those in which a shock wave occurs. A. SCHOFIELD

533.6.011 : 536.483

A simply constructed vortex tube for producing hot and cold air streams. *See Abstr.* 5785

MOLECULAR THEORY OF GASES 533.7

533.7

5598. Argon repulsive potential from collision cross-section measurements. I. AMDUR, D. E. DAVENPORT AND M. C. KELLS. *J. Chem. Phys.*, **18**, 525–8 (*April*, 1950).

The total collision cross-section has been measured for A atoms, with energies between 300 and 1 100 eV, scattered in room temperature A. In the region between 700 and 1 000 V, the cross-section shows a maximum indicative of inelastic scattering, probably due to ionization by the high energy atoms. The repulsive potential between 2 A atoms has been evaluated from elastic collision cross-sections (deduced from observed values of the total collision cross-section) using a method which takes account of the greater probability of small angle scattering by averaging the cross-section over the length of the scattering path. The results may be expressed by $V(r) = 4{\cdot}61 \times 10^{-11}/r^{4{\cdot}33}$ ergs or $V(r) = 3{\cdot}66 \times 10^{-8} \exp(-6{\cdot}88r^{\frac{1}{2}})$ ergs for values of r between 1·37 and 1·84 Å. A.

533.7 : 536.71

5599. Determination of intermolecular forces from the equation of state of gases. T. KIHARA. *J. Phys. Soc. Japan*, **3**, 265–8 (*July–Aug.*, 1948).

The 2nd virial coefficient is not sensitive to the shape of the interaction energy $U(r)$ between the molecules but the 3rd is. The latter is deduced and, taking $m = 6$, $n = 12$, in the equation $U(r) = \lambda/r^n - \mu/r^m$, numerical values are calculated, using parameters determined from the 2nd virial coefficient, and compared with experiment for 4 gases. There is systematic disagreement indicating inadequacy in the model. F. E. HOARE

533.7 : 536.75

5600. On the kinetic theory of rarefied gases. H. GRAD. *Commun. Pure Appl. Math.*, **2**, 331–407 (*Dec.*, 1949).

The gases are restricted to those consisting of monatomic molecules. The aim of the paper is to obtain precise results in simple problems rather than rough approximations to the behaviour of complex physical systems. The various assumptions made are critically examined. Some properties of the Boltzmann equation are studied and an approximate solution in Hermite polynomials is obtained. The 3rd-order approximation is carried through, and the characteristics of the equations obtained in this approximation are calculated. Entropy and the H-theorem (H is essentially the thermodynamic entropy) are discussed in the last section.

L. S. GODDARD

533.7 : 539.132

5601. Molecular physics and the virial theorem. A. MICHELS AND S. R. DE GROOT. Letter in *Physica*, **16**, 183–4 (*Feb.*, 1950).

A method is outlined in which use is made of the virial theorem to obtain the kinetic and potential energy of a molecule using an approximation for the effect of neighbouring molecules. Curves are given showing the results for the 1*s*, 2*s*, 2*p* states of atomic H.

F. E. HOARE

533.72 : 536.71

5602. On states not in thermal equilibrium (induction of the equation of motion of gas). T. KOGA. *J. Phys. Soc. Japan*, **4**, 34–8 (*Jan.–Feb.*, 1949).

An approach to the study of irreversible phenomena. The case of a gas proceeding towards thermal equilibrium and consisting of molecules of one kind only is considered. It is assumed that the whole field of the gas can be split up into very small elements, in each of which the gas can be considered to be in equilibrium, and furthermore that these elements can be made sufficiently small to allow differentiation of quantities all over the field as if they are continuous.

T. C. TOYE

533.75 : 536.71

5603. A special form of the equation of state. C. KÄMMERER. *Ann. Phys., Lpz.* (*Folge* 6) **4** (*No.* 6) 325–30 (1949) *In German.*

An equation of state containing 4 constants is discussed. Making use of the usual conditions for the critical point this may be written in a reduced form containing the ratio $p_c v_c/RT_c (= x)$. The value of x varies for different substances and therefore the numerical values of the coefficients also. Starting with the same equation but only making use of the critical condition $(dp/dv)_T = 0$, another reduced equation is obtained containing x and an adjustable constant which may take different values according as the reduced volume is $>$ or $<$ 1. Calculated and tabulated values of the pressure are compared for water and CO_2 (reduced volume $>$ 1 only). Finally, a modification of the equation is discussed and from this the value of (dp/dT) for the saturated vapour at the critical point deduced and compared with experiment. F. E. HOARE

533.75 : 536.71

5604. On the equation of state for rarefied real gases. F. SAUTER. *Ann. Phys., Lpz.* **6,** 59–66 (1949) *In German.*

After a criticism of the usual elementary basis of Van der Waals' theory corrections to the equation of state for gases it is shown that only the Boltzmann method is really applicable. It is also shown that the correction for Van der Waals' forces may be calculated quantitatively in an analogous manner. The cumbrous method of the virial theorem is unnecessary, especially as it is inapplicable without modification when there is interaction between the gas molecules and the walls of the containing vessel. This case may also be treated by elementary methods and in this way it is shown that the pressure of rarefied real gases is independent of the interaction between the gas molecules and the walls. F. E. HOARE

VIBRATIONS . ACOUSTICS 534

534.1

5605. Resonance curves for forced oscillations, produced by disturbances with frequency-dependent amplitude. M. PÄSLER. *Ann. Phys., Lpz.* (*Folge* 6) **4** (*No.* 1–2) 1–13 (1948) *In German.*

The oscillations of a mechanical system are considered, when the disturbance has an amplitude proportional to the nth power of its frequency ω. The differential equation for the system is then, $x + 2\delta\dot{x} + \omega_c x = k\omega^n e^{j\omega t}$. Curves showing the variation, with ω, of the amplitude of x are given for the cases $n = 0, 1, 2, 3, 4$. L. S. GODDARD

534.1

5606. Oscillations of finite chains of points. W. BRAUNBEK. *Ann. Phys., Lpz.* (*Folge* 6) **4** (*No.* 3–4) 169–73 (1948) *In German.*

The particles are of equal mass and the coupling-constant between neighbouring particles is k; for the end particles the constant is k_1. The proper frequencies and modes of oscillation are worked out explicitly in these cases: (1) $k_1 = 0$, (2) $k_1 = k$, (3) $k_1 = 2k$, (4) $k_1 = \infty$. L. S. GODDARD

534.121.1

5607. Vibrations of free elliptical plates. M. D. WALLER. *Proc. Phys. Soc., Lond. B,* **63,** 451–5 (*June,* 1950).

The systematic observations which have been made on the normal vibrations of free elliptical plates confirm Chladni's results. The nodal systems may be divided into the same 4 classes of symmetry as those of rectangular plates. The correspondence which exists between the vibrations of elliptical, rectangular and circular plates is traced. Combined modes of vibration do not occur on elliptical plates as they occasionally do on rectangular plates. A.

534.13 : 534.37

5608. The differential equation for the time dependence of thermally damped elastic oscillations. M. PÄSLER. *Ann. Phys., Lpz.* (*Folge* 6) **4** (*No.* 1–2) 14–24 (1948) *In German.*

A variational method is used to derive the equation in its most general form. The equation is of the 3rd order, with constants depending on the materi The equation formerly obtained by Bennewitz a Rötger [*Phys. Z.,* **37,** 578 (1936)] appears as a spec case. L. S. GODDA

534.1

5609. Torsional vibrations of coupled cylinde M. F. KILPATRICK AND J. E. KILPATRICK. *J. Acou Soc. Amer.,* **22,** 224–30 (*March,* 1950).

Equations have been derived to give the torsion vibrational frequencies of a system consisting of tv identical cylinders joined axially by means of a thi cylinder. Such a system corresponds satisfactori to the experimental set-up frequently used to dete mine the modulus of rigidity of a sample. T relation of the frequency spectrum to the vario parameters of the system is discussed in detail. Tw sets of experimental frequency data are compare with the results of the theoretical equations.

534.141

5610. On edge-tones in gas streams of circular an plane laminar cross-section. H. VON GIERKE. *angew. Phys.,* **2** (*No.* 3) 97–106 (1950) *In German.*

An experimental investigation of the characteristic and mechanism of sound production by a stream gas issuing from (*a*) a parallel-sided circular hol (*b*) a circular hole with a circular knife edge of th same dia. in the emergent stream; (*c*) a slit with knife edge in the emergent stream. The dependenc of frequency upon gas-velocity, upon stream width and upon the distance of the knife edge from th orifice h was examined. Stroboscopic observation c a visible gas stream showed that the production c sound by a circular stream is due to its sheddin periodic vortices from its periphery; the distance between the vortices when they are formed i approx. = vortex. dia. When an obstacle, such a a knife edge, is placed in the gas stream the pressur distribution is modified, and the frequency of th note emitted is determined by h and the vorte velocity. For certain values of h a sudden frequenc variation occurs; this happens when h is approx. = multiple of l and the change of frequency is associate with a change in the no. of vortices between the knif edge and the orifice. A similar effect was found i the case of a knife edge in the laminar stream issuing from a slit. A. SCHOFIELI

534.2

5611. Abnormal absorption of sound waves i water. Y. TAKESADA. *J. Phys. Soc. Japan,* **4,** 356– (*July–Dec.,* 1949).

A short note dealing with the attenuation pheno mena due to the generation of small non-resonan air-bubbles when high power h.f. sound waves are transmitted through water. Curves showing the attenuation with distance illustrate that the gradient $(\Delta\rho/\rho)$ of the sound wave is decreased abnormally near the sound source. With a radiator area o 10 cm² and a wavelength 10 cm, a sound power o 1 000 W at the source falls to $\frac{1}{10}$ in a distance o 100 cm. A. B. WOOD

534.21

5612. Sound absorption in binary gas mixtures. M. KOHLER. *Z. Phys.,* **127** (*No.* 1–2) 41–8 (1950) *In German.*

Extension of the author's theory of sound absorp-

ion in binary mixtures of monatomic gases [Abstr. 628 (1941)] by Meixner [*Ann. Phys.*, **43**, 470 (1943)] ; discussed with special reference to case where ratios f molecular mass and diameter are large. Numerical alculations based on experimentally found constants re given for 50% A–He and 50% A–H_2 mixtures, and : is shown that the absorption of the mixture > bsorption of pure gas. T. S. E. THOMAS

534.21

613. Acoustic absorption coefficients at high frequencies. W. S. CRAMER. *J. Acoust. Soc. Amer.*, **22**, 60–2 (*March*, 1950).

The measurement of the acoustic absorption coefficient by a steady state method was carried out at requencies of 9, 20 and 30 kc/s for 7 different naterials. This involved the construction of a sound hamber with facilities for creating a diffuse sound ield and a sample area where materials could be nounted. The average intensity in the chamber was neasured with the sample area covered with the naterial under test and the results compared with imilar measurements when the area was covered uccessively with a material of negligible absorption nd when it was open to the air outside. The expression giving the absorption coefficient in terms of hese three relative intensity readings is derived. A.

534.21

614. The determination of reverberant sound absorption coefficients from acoustic impedance measurements. A. LONDON. *J. Acoust. Soc. Amer.*, **22**, 263–9 (*March*, 1950).

A method is described for utilizing normal absorption coefficient or acoustic impedance measurements o predict reverberant sound absorption coefficients. The average of coefficients for the 6 standard frequencies determined from acoustic impedance measurements agrees closely with the average reverberant oefficient, for cases where the material may be said o obey the normal impedance assumption. The ormal absorption coefficients of some 26 different coustic materials were measured at 512 c/s. Using he method given in the paper, the predicted reverberant coefficient deviated from the measured everberant coefficient by 0·05 or less for 18 materials, while in only 3 cases were the deviations > 0·10. he theoretical development is given. A.

534.21 : 533.16

Compression- and shear-viscosity in gases. *See Abstr.* 5590

534.21 : 534.321.9

615. On the propagation of ultrasonic waves in liquids. A. CARRELLI AND F. PORRECA. *Nuovo Cim.*, , 94–8 (*March*, 1950) *In Italian.*

A liquid behaves as a diffraction grating when tanding u.s. waves are excited in it. The present aper is an experimental study of the effect of changes n viscosity on the maxima of the diffraction pattern. L. PINCHERLE

534.21 : 534.37 : 539.31

616. On the thermo-elastic effect. A. NOMOTO. *. Phys. Soc. Japan*, **4**, 359–60 (*July–Dec.*, 1949).

Thermal effects cause the velocity of a dilatational vave in an isotropic elastic solid to vary with the requency. Two distinct types of thermo-elastic waves are possible, one approximately the same as an isothermal wave, the other a highly dispersive wave. Two functions of the frequency associated with each type, an index of refraction and a coefficient of damping, are derived from the differential equation satisfied by the dilatation. J. G. OLDROYD

534.212

5617. The propagation of a sound pulse in the presence of a semi-infinite open-ended channel. I. W. CHESTER. *Philos. Trans. A* (*No.* 854) 527–56 (1950).

The behaviour of a sound pulse approaching and progressing beyond the open end of a semi-infinite channel is discussed. A succession of diffracted waves is created at the open end for which a general formula is obtained, by operational methods, when the pulse originates inside the channel. With the aid of a simple reciprocity relation the asymptotic behaviour of these diffracted waves can be used to deduce the form of the wave returning along the channel when the original pulse approaches the open end from an arbitrary direction. Ultimately the returning wave becomes sensibly plane and separates into regions of length equal to the width of the channel, the form of the potential depending on the number of diffracted waves which contribute to each particular region. Explicit expressions are obtained for the potential in the first two regions at the head of the returning wave and for the third region when the pulse originates inside the channel. The case of an initial velocity distribution given by the Heaviside unit pulse is treated in detail. A.

534.213

5618. Transmission of reverberant sound through double walls. A. LONDON. *J. Acoust. Soc. Amer.*, **22**, 270–9 (*March*, 1950).

534.213.4

5619. Properties and use of cylindrical sound conductors. J. MERHAUT. *Slabopr. Obz.*, **10**, 189–92 (*Oct.*, 1949) *In Czech.*

The characteristics of tubular sound conductors are derived from the consideration of the exponential horn (of infinite length). Olson's and Klipsch's formulae for the true impedance in the throat of an exponential horn are discussed (input impedance), whereas the expression for the open mouth impedance (output impedance) is derived from Rayleigh's formula for a circular disc of a diameter corresponding to that of the mouth. Relative values of the real and imaginary components of this acoustic impedance are given in a graph, another showing the same for the input impedance. The application of these principles to straight cylindrical sound conductors leads to complicated integrations which still prove to be strictly soluble (by substitutions). The importance of such straight conductors in measuring technique is shown (e.g. measurements on loudspeakers and microphones) and the limitations of the theory are determined. B. F. KRAUS

534.221

5620. The velocity of compressional waves in rods of rectangular cross section. R. W. MORSE. *J. Acoust. Soc. Amer.*, **22**, 219–23 (*March*, 1950).

Two general modes of propagation are constructed

which satisfy the boundary conditions for the free vibrations of a long rod for which the width $2d$ is $\gg$ the thickness $2a$. The thickness mode is shown to have an infinite phase velocity (cut-off frequency) at that frequency for which the half wavelength in an infinitely wide rod $= 2d$. The phase velocity of both of these propagation modes is shown to approach that of Rayleigh surface waves when the wavelengths are $\ll$ the lateral dimensions. The calculated thickness mode cut-off frequencies are compared with measurements reported earlier and the agreement is shown to be good. A comparison between the predicted and measured phase velocity dispersion is made for various values of a/d. The agreement is found to be satisfactory as long as d is several times $> a$. A.

534.222.2

5621. The acoustic blastmeter. J. G. Dawes. *J. Sci. Instrum.*, **27**, 123–7 (*May*, 1950).

A method is described for measuring and recording the speed of a rapidly changing blast of air. The method depends on the change in phase of an acoustic signal received at a point, the phase shift being a function of the velocity of the air between the sound transmitter and receiver. Tested in a laboratory gallery with a series of steady air blasts ranging from 25 to 125 ft/s, the method gave results closely corresponding with the air velocities measured by an independently calibrated orificemeter. It is capable of rapid response and of dealing with a wide range of air speeds. It is proposed to employ the method to record the changing speed of the air blast which precedes the flame of an explosion travelling along a gallery. A.

534.222.2 : 533.6.011

On the theory of cylindrical shock wave. *See Abstr.* 5597

534.23 : 534.321.9

5622. Propagation velocity of ultrasonic waves in ideal mixtures. G. Natta and M. Baccaredda. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **4**, 360–6 (*April*, 1948) *In Italian.*

The results of determinations of the propagation velocity (V) of ultrasonic waves in ideal binary liquid mixtures, by the sp. vol. method, have enabled a formula to be derived giving V of the mixture in terms of the d and V of the pure constituents and of the d of the mixture. This expression demonstrates the additivity of V in the systems studied (e.g. cyclohexane + decalin, *n*-heptane + polyisobutylene and aqueous sucrose solutions). Comparison of these V results with those obtained from Schaaff's formula (1937) shows that in general the former are the lower and correspond more closely with the experimental values. When, however, the products $V \times d$ for the 2 pure constituents of the mixture (e.g. C_6H_6 + C_6H_5Cl and C_6H_6 + camphor) are similar, then the 2 formulae give almost coincident V values.

J. Grant

534.231.3

5623. The acoustical impedance of closed rectangular loudspeaker housings. W. F. Meeker, F. H. Slaymaker and L. L. Merrill. *J. Acoust. Soc. Amer.*, **22**, 206–10 (*March*, 1950).

534.23

5624. Acoustic circulation effects and the nonlin impedance of orifices. U. Ingård and S. Laba *J. Acoust. Soc. Amer.*, **22**, 211–18 (*March*, 1950).

Studies of acoustical streaming phenomena arou orifices have been made by the use of smoke partic in a 3-in diameter circular tube. These stud covered a range of orifices from thicknesses 0·5 mm to 19 mm and diameters of 3·5 mm to 20 m The frequency lay between 150 to 1 000 c/s. Velocit in the orifice cover the range of 0 to 700 cm/s. Stud of the flow patterns have disclosed that there exis definite regions of flow as the particle velocity in orifice is increased. These regions have been rep sented by "phase diagrams." Photographs of various flow patterns in each region of the "pha diagram" have been taken for a number of orific Under each observed condition, the acoustic i pedance of the orifice is determined by a convention standing-wave measurement in the tube. It is sho that the nonlinear properties of the acoustic imp dance of an orifice is closely connected with t circulation effects. Quantitative check in one of t circulation regions and a good qualitative over- agreement indicate that the nonlinear properties the impedance is due to the interaction between t sound field and the circulatory effects.

534.2

5625. Radiations from a rigid diaphragm provid with a closed acoustic screen. P. G. Bordoni an W. Gross. *Atti Accad. Naz. Lincei* (*R.C. Cl. S Fis. Mat. Nat.*) **1**, 395–401 (*March–April*, 1946) *Italian.*

Mathematical discussion of a direct method obtaining approximate value of sound radiation fro a rigid diaphragm vibrating in a closed acoust chamber. The method is developed from the co sideration of sound radiation produced by oscillating piston acting on a sphere. W. W. Ge

534.22

5626. A magnetostriction vibrator of Al–Fe allo Y. Takesada. Letter in *J. Acoust. Soc. Amer.*, 2 290 (*March*, 1950).

534.232 : 538.56

5627. Field of a point source of radiation in stratified-inhomogeneous medium. I. Integral for of the solution. L. M. Brekhovskikh. *Izv. Aka Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 5) 505–14 (1949) *Russian.*

A generalization of former work of the autho [*Dokl. Akad. Nauk, SSSR*, **48**, 422 (1945); *Izv. Aka Nauk, SSSR, Ser. Fiz.*, **10**, 491 (1946); and P. Ryazin, Abstr. 923 (1947)] by including propagatio of waves in a stratum bounded not only by shar but also by "washed-out" surfaces of separatio As in the earlier work, the problem is treated for th electromagnetic in parallel with the acoustic cas The integral solution involving Bessel functions transformed into another involving Hankel function i.e. the expression of the plane wave, and is suppl mented by another representing the spherical wav The author then uses Weyl's well-known metho introducing the Hertz vector for obtaining phas relations and Fresnel reflection coefficients. Th usefulness of the solution is shown by 4 cases and

supplement adds the existence and uniqueness theorems. B. F. KRAUS

534.232 : 538.566

5628. Field of a point source of radiation in a stratified-inhomogeneous medium. II. Discussion of the solution. L. M. BREKHOVSKIKH. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 5) 515–33 (1949) *In Russian.*

The author shows that the solution obtained in the first part is of practical use, i.e. not only suitable for idealized problems. The integral representing spherical waves is resolved into plane waves and so-called inhomogeneous waves, the latter formally equivalent to plane waves, but with complex angles of incidence. The integral solution is evaluated by complex integration, the expressions obtained representing the "discrete" and "continuous" wave spectrum of the problem. A comprehensive analysis of the lateral waves by a method of the author published earlier [*Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **10,** 491 (1946); Abstr. 1884 (1950)] and of the discrete spectrum is followed by two practical examples, the second of which represents the case of a plane wave-guide with walls of finite thickness. B. F. KRAUS

534.232 : 538.566

5629. Field of a point source of radiation in a stratified-inhomogeneous medium. III. Average laws of attenuation. L. M. BREKHOVSKIKH. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 5) 534–45 (1949) *In Russian.*

The two kinds of waves emitted by the source, viz. those of the "discrete" spectrum and the two lateral waves, are damped according to two different laws; the first of the form $\exp(-\beta_l r)/\sqrt{r}$, and the second of the form $\exp(-\gamma_i r)/r^2$ where the two coefficients β_l, γ_i, are imaginary. The physical character of the damping process is also different in the two cases, viz. a leakage of energy through the boundary layers in the first case, in the second, absorption of the waves in the boundary layers. At a great distance from the source the field is determined by the least damped wave of the discrete spectrum, or by the lateral waves; at short distances, however, other waves of the discrete spectrum become important too, whereas the lateral waves have only a negligible influence. The field in the layer has a complicated interference structure owing to the superposition of the waves of the discrete spectrum. The formulae of Parts I and II permit of averaging processes which simplify the picture and make physical sense. B. F. KRAUS

534.24

5630. Phase distortion of acoustic pulses obliquely reflected from a medium of higher sound velocity. A. B. ARONS AND D. R. YENNIE. *J. Acoust. Soc. Amer.*, **22,** 231–7 (*March*, 1950).

The shape of the pressure wave reflected from a semi-solid bottom is derived for the specific case of exponentially decaying shock waves produced in underwater explosions, and the theoretical predictions are found to agree well with the observed pressure-time curves of the first and successively higher order reflections. The theoretical analysis assumes acoustic plane waves incident upon an interface between two fluid media. Experimental records were obtained at relatively great distances from the charge so that finite amplitude effects were negligible and the radius of curvature of the wave front quite large. A.

534.26

5631. On the dispersion and absorption of supersonic waves in water. B. B. GHOSH. *Indian J. Phys.*, **24,** 1–12 (*Jan.*, 1950).

A theoretical expression for the dispersion of supersonic waves in water has been deduced on the basis of water structure and structural compressibility. The experimental results as reported in previous papers, have been compared with the results calculated from this expression and are found to be in good agreement. Further, theoretically deduced formula for absorption, similar to one published in an earlier paper, has been used to calculate the frequency for maximum absorption for water due to structural vibrations at different temperatures. The calculated values indicate that the mean frequency region for dispersion for associated liquids such as water, lies in the neighbourhood of 10^9 to 10^{10} c/s. A.

534.321.9

5632. Intensity measurement of ultrasonic waves in liquid. E. WADA. *J. Sci. Res. Inst., Tokyo*, **44,** 127–9 (*Feb.–March*, 1950).

To obtain the detail of intensity distribution of progressive ultrasonic waves easily, in direct reading, in absolute value and independent of the frequency, a spherical sonic radiometer was used with satisfactory results which were compared with those obtained by other customary methods. A.

534.321.9

5633. Resonant acoustic interferometry with air-liquid reflecting surface. J. L. HUNTER AND F. E. FOX. *J. Acoust. Soc. Amer.*, **22,** 238–42 (*March*, 1950).

An ultrasonic interferometer has been developed using an air-liquid surface as a reflector. Because of certain simplifications that occur, it is found advisable to recast the mathematical interpretation of the results along different lines from previously. The effect of a loaded piezoelectric crystal at resonance is taken as a variable resistance, and the measured values of this resistance are interpreted to calculate absorption in the liquid. A.

534.321.9

5634. A new ultrasonic interferometer for liquids. J. L. HUNTER. *J. Acoust. Soc. Amer.*, **22,** 243–6 (*March*, 1950).

An interferometer has been developed which makes use of the free surface of a liquid as a reflector. The emitter is an optically plane quartz crystal which is held perfectly horizontal at the bottom of a vertical liquid column. Changes in the column height produce the effects which are used to measure absorption in the liquid. A sensitive method of adding liquid makes the instrument usable at frequencies well above 6 Mc/s. The levelling is sensitive and positive. A.

534.321.9

5635. Chemical effect of ultrasonic waves: oxidation of potassium iodide solution by carbon tetrachloride. A. WEISSLER, H. W. COOPER AND S. SNYDER. *J. Amer. Chem. Soc.*, **72,** 1769–75 (*April*, 1950).

The amount of I liberated by ultrasonic waves from KI–CCl_4 aqueous solutions depends on the dimensions

and material of the reaction vessel. Although dissolved O has formerly been considered essential, N or H are found to serve almost as well. As the power input is increased, no I is produced until cavitation occurs. Then the yield increases almost linearly if the volume of solution is large enough, but for smaller volumes the yield first increases and then decreases sharply. The main reaction is that between H_2O and dissolved CCl_4, the KI being primarily an indicator of the oxidizing chlorine set free. Rate studies indicate that the reaction takes place in 2 steps, each of which liberates 2 Cl atoms per CCl_4 molecule. The first step is approximately 10 times faster than the second. In the absence of CCl_4 the oxidation of KI solution proceeds only about one-fifteenth as rapidly as in the presence of CCl_4. A.

534.321.9

5636. Summarized proceedings of symposium on applications of ultrasonics. G. BRADFIELD. *Proc. Phys. Soc. Lond. B*, **63**, 305–22 (*May*, 1950).

Recent advances in (*a*) the investigation of the fundamental structure of matter, (*b*) telecommunication and allied applications, and (*c*) use of mechanical forces set up by intense waves were surveyed. In (*a*) derivation of elastic constants of matter was important, especially as small samples could be used. Losses incurred in propagating waves were surveyed and relaxation phenomena based on Maxwell's hypothesis of shear-elasticity as a time function and on Kneser's treatment of loss due to delay in a storage process were represented. Available sources of ultrasonic power were surveyed and the importance of barium titanate as a powerful and strongly coupled piezoelectric transducer was emphasized. An expression for the receiver/transmitter power ratio in telecommunications systems was examined and optimum frequencies for various ranges were deduced. Accounts were given of experience with flaw detectors and echo-sounding which showed that these were becoming important industrially and in navigation; work on blind aids was unpromising. Advances in timing and time delay devices were described. The importance of the study of cavitation was pointed out. Results were discussed for killing bacteria, disintegrating proteins, emulsifying, soldering aluminium and refining the crystalline structure in solidification of light alloys. A.

534.321.9 : 532.5

5637. On the forces producing the ultrasonic wind. F. E. FOX AND K. F. HERZFELD. *Phys. Rev.*, **78**, 156–7 (*April* 15, 1950).

The ultrasonic wind has been erroneously ascribed to a pumping action of the quartz oscillator. Eckart has investigated it starting from the hydrodynamical equations. Without adding anything essentially new to his calculations, it is shown here that the cause of the wind is the linear momentum of the wave motion taken up by the liquid through sound absorption. A.

534.321.9 : 532.7

Molecular structure and ultrasonic velocity in pure liquids. *See Abstr.* 5575

534.321.9 : 541.6

5638. Effect of ultra-sound on the phenomenon of orthotropism in organic substances. A. P. KAPUSTIN. *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 2) 273–4 (19 *In Russian.*

534.321.9 : 54

5639. Obtaining textures in crystalline substan by means of ultrasonic waves. A. KAPUSTIN. *D Akad. Nauk, SSSR*, **71** (*No.* 3) 451–2 (1950) *In Russ*

Standing waves ($\lambda \sim 3$ mm) set up in a tube c taining gelatine solution caused black particles suspension to congregate in the nodal planes. I suggested that periodic textures, related to phenomena of Liesegang rings and zoned cryst could be produced by this means. Crystallizatio molten Rochelle salt spread outwards from pla $\lambda/2$ apart and on remelting these planes again beca visible. A. L. MACK

534.321.9 : 59

5640. Measurements of the ultrasonic cries of ba D. R. GRIFFIN. *J. Acoust. Soc. Amer.*, **22**, 247- (*March*, 1950).

The ultrasonic sounds emitted by bats have be analysed with a system sensitive to frequencies fr 1 to 150 kc/s. These sounds are used by the bats detect obstacles by means of their echoes; and th consist of pulses about 2 msec in duration. M of the measurements were made with the comm little brown bat, *Myotis l. lucifugus*; with this spec the sound pressure at 40 to 55 kc/s, measur 5 to 10 cm from the animal's mouth, averag 60 dynes/cm² (109 db on the conventional scale sound pressure levels). The highest recorded tensity was 173 dynes/cm² (119 db). The frequen of the ultrasonic sound falls during each pulse about one octave; the average frequency at the pe amplitude was 47·8 kc/s, while the average at t beginning of the pulse was 77·9 kc/s, and at the e 39·1 kc/s. Low frequency waves (about 10 kc accompany the pulse, but their amplitude is a ve small fraction (1/100 to 1/1 000 or less) of the pe sound pressure at ultrasonic frequencies. T envelope form is variable; the emission is direction with most of the energy concentrated into the forwa direction; and the pulses are commonly repeated rates of 20 to 30 per second.

534.

5641. Mathematical treatment on the decay of vibrating system due to the emission of sound wa into the surrounding medium. Z. SAKADI AND TAKIZAWA. *J. Phys. Soc. Japan*, **3**, 235–41 (*July Aug.*, 1948).

The damping factors are calculated in the followir 7 cases: (1) radial vibration of an elastic sphere in ai (2) infinitely extended membrane, (3) torsion vibration of an infinite circular cylinder in a viscou fluid, (4) transverse vibration of an infinite stretche string, (5) infinitely extended plate, (6) longitudina vibrations of an infinitely thin rod in a viscous fluid (7) radial vibrations of a circular cylinder in air.

L. S. GODDAR

534.

5642. On theory of optical sound analysis. PICHT. *Ann. Phys., Lpz.* (*Folge* 6) **5** (*No.* 3–5) 117–3 (1949) *In German.*

Closer study of the theory is made. Formula giving the relationship between the light intensit

hrough the variable density film, and the amplitude nd frequency of the sound, are derived, and applied n the analysis of complex sound. W. W. GEHR

534.413

5643. Chemical action of sound waves on sensitive lames. Z. CARRIÈRE. *J. Phys. Radium*, **11**, 124–30 *March*, 1950) *In French*.

The luminous emission of a flame stratified by a sound wave (frequency 1370) has been analysed spectrographically. The rectilinear spectrograph slit, normal to the real image of sensitivity fringes projected on to the slit through a stroboscopic wheel, s divided into sections equal to each other and to the nter-fringe distance. The fixed intensity varies in he corresponding spectral bands from a maximum to a minimum value, at least in the case of the characteristic emission of Swan bands. Hence, the C molecules ormed by the dissociation of C compound (coal-gas) nd probably responsible for these radiations, exhibit n the flame under the action of sound waves places of maximum and minimum density. The specific accelerating activation of dissociation, which starts in the sensitive region of the flame, continues and extends up to the top layers of the flame.

F. LACHMAN

534.6 : 621.395.6.08

5644. Acoustic measurements. L. L. BERANEK. *London, Chapman and Hall*; *New York, John Wylie* (1950) 914 *pp*.

Subjects covered are: history of acoustics; terminology; attenuation; scattering and non-linear distortion in wave-propagation; diffraction phenomena around various obstacles (spheres, cylinders, the human body, etc.), and around sources of sound in finite baffles; primary techniques for the measurement of sound pressure and particle velocity and for the absolute calibration of microphones ("reciprocity" technique of calibration, the theory and use of the Rayleigh disc); primary sources of sound (thermophone, pistonphone, and the electrostatic actuator); characteristics of the ear (referring to Fletcher's "equal loudness" curves); microphones (carbon, condenser, piezoelectric types) and their directional properties; primary frequency standards (crystal clocks); laboratory frequency standards (pendulum clocks, precision forks); ordinary frequency standards (audio-oscillators, electronic meters, Wien bridge, etc.); frequency comparison methods; measurement of acoustic impedance (including motional impedance); the audiometers; sound sources for test purposes (vocal, low intensity, high intensity and explosive); characteristics of random noise (a statistical study); indicating and integrating instruments for the measurement of complex waves (peak, average, r.m.s., and power meters); analysis of sound waves (steady and transient sounds, calibration of sound analysers); basic tests for communication systems (the rating of microphones, amplifiers and loud speakers); tests for laboratory and studio microphones; tests for loud speakers; articulation test methods; measurement of acoustic properties of rooms, studios and auditoriums; measurement of acoustical materials, the sound level meter. The book covers a very wide field and is likely to be mainly of interest to acoustical and communication engineers who will find it useful for reference purposes. A. B. WOOD

534.613

5645. A comparison of the Rayleigh disk and the acoustic radiometer methods for the measurement of sound wave energy. J. HARTMANN AND T. MORTENSON. *IngenVidensk. Skr.* (*No.* 2) 65 *pp*. (1948).

Absolute measurement of sound energy is based on two well-known methods, viz. the Rayleigh disc and the acoustic radiometer. Rayleigh's theory of the radiometer led to an expression for pressure S dynes/cm² which is equal to twice the energy density E erg/cm³ in the incident wave train, i.e. $S = 2E$. This expression was later modified by Rayleigh to $S = (K + 1)E$ where $K = C_p/C_v$ the ratio of specific heats for the gas in question. The present paper describes a comprehensive series of experiments in which the "disc" and "radiometer" methods are compared. The results of these two methods agree well with the first formula $S = 2E$ for the radiation pressure. A. B. WOOD

534.75

5646. The discriminability of interaural phase relations in two-component tones. J. C. R. LICKLIDER AND J. C. WEBSTER. *J. Acoust. Soc. Amer.*, **22**, 191–5 (*March*, 1950).

534.75

5647. Discrimination of pitch in short pulses of sound. C. L. S. GILFORD AND T. SOMERVILLE. Letter in *Nature, Lond.*, **165**, 643 (*April* 22, 1950).

Results are given of controlled tests using two different pulse lengths at 6 frequencies where the subjects were asked to adjust an a.f. oscillator to the same pitch as that of the given pulses, received under various transmitting conditions. Pulses which are too short to give a clear impression of pitch when heard directly from a loud-speaker assume a more definite pitch when radiated into an auditorium. The implications of this phenomenon on present theories of hearing are briefly mentioned. G. F. HODSMAN

534.75 : 534.773.2

5648. The relation between localization and intelligibility. I. J. HIRSH. *J. Acoust. Soc. Amer.*, **22**, 196–200 (*March*, 1950).

534.78

5649. The speaking machine of Wolfgang von Kempelen. H. DUDLEY AND T. H. TARNOCZY. *J. Acoust. Soc. Amer.*, **22**, 151–66 (*March*, 1950).

Wolfgang von Kempelen produced the first speaking machine around 1780. His background, a description of the apparatus he built, and a discussion of the methods used in producing the various sounds are given, his work being fitted into the over-all picture of speech-imitating devices from the speaking of idols of ancient times down to the automatic electrical reconstructing of speech in the vocoder. For portraying to the eye the physiological characteristics of speech there are discussed the more outstanding methods from symbolic alphabets of ancient languages down to the recent spectrographic visible speech. A.

534.78

5650. The intelligibility of interrupted speech. G. A. MILLER AND J. C. R. LICKLIDER. *J. Acoust. Soc. Amer.*, **22**, 167–73 (*March*, 1950).

534.78 : 621.395

5651. The perception of speech and its relation to telephony. H. FLETCHER AND R. H. GALT. *J. Acoust. Soc. Amer.*, **22**, 89–151 (*March*, 1950).

The intelligibility of the speech received over a communication system is usually expressed in terms of one or another measure such as the vowel or the consonant articulation, the average speech sound articulation, the syllable articulation, the word articulation, or the sentence intelligibility. Relationships are established among several of these measures and the articulation index. Relationships based upon statistical considerations are compared with the results of observations. Functions are developed which permit the calculation of articulation index and hence of articulation for communication systems which include a wide variety of response *v.* frequency characteristics and of noise conditions, as well as several special types of distortion. Although the treatment is predominantly empirical, the functions and processes are closely related to various fundamental properties of speech and hearing. Four principal series of articulation tests are cited in detail. The response and the noise, if any, are given for each of these cases and the observed articulations are compared with values calculated by the method presented. A.

534.785 : 534.843

5652. The effect of room characteristics upon vocal intensity and rate. J. W. BLACK. *J. Acoust. Soc. Amer.*, **22**, 174–6 (*March*, 1950).

534.792

5653. Loudness patterns—a new approach. W. A. MUNSON AND M. B. GARDNER. *J. Acoust. Soc. Amer.*, **22**, 177–90 (*March*, 1950).

A comparison between the loudness of a primary tone, as evidenced by the magnitude of its residual masking pattern, with the results of loudness judgment tests was made. This was done by replacing the physical scales of pressure level and frequency by the subjective scales of loudness and position. A reasonably good check of computed and measured loudness values was obtained. Patterns for a 1 000 c/s tone were measured to show how the loudness of the standard reference tone is distributed and how this distribution changes as the level of the tone is increased. A.

534.836

5654. Levels and spectra of transportation vehicle noise. G. L. BONVALLET. *J. Acoust. Soc. Amer.*, **22**, 201–5 (*March*, 1950).

The investigation included street, elevated and subway cars; Diesel, steam and electric trains; and motor buses, trucks and automobiles. Measurements were made of over-all and octave band levels. Inside the vehicles, flat network over-all levels ranged from 85 db in a new elevated car to 95 db in subway cars. The readings in the 400–800 c/s band ranged from 68 db in an automobile to 91 db in subway cars. Outside of and close to vehicles, the flat network over-all levels ranged from 78 db for automobiles to 94 db for subway trains. Observations in the 400–800 c/s band ranged from 66 db for automobiles to 87 db for subway trains. Variations in the over-all levels inside vehicles ranged from ± 1 to ± 5 db. Variations in the 400–800 c/s band ranged from ± 2 to ± 5 db. Outside the vehicles, variations ranged from ± 2 to ± 6 db in both the over-all and 400–800 c/s band levels. A.

534.84

5655. Distributed sound source systems. B. D. TARTAKOVSKIĬ AND R. E. GASSKO. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 6) 654–61 (1949) *In Russian.*

Discussion of advantages of the distributed over the centralized loudspeaker systems. W. W. GEHR

534.84 : 621.395.623.7 : 621.395.645

5656. Survey of work on sound amplification in the U.S.S.R. I. G. DREĬZEN. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 6) 666–73 (1949) *In Russian.*

Developing the theory that a system of sound amplification in a building, embodying a microphone, an amplifier unit and one or more loudspeakers, can physically be interpreted as a partially infinite chain of sound radiators with a progressively diminishing feedback coefficient, with the increase of distance from the microphone, two cases of boundary reflection are treated, viz.: (*a*) where the reflected sound pressure waves are in phase with the incident waves; (*b*) where the phase relationship is random and can only be referred to in terms of the intensity of reflected, individual sound waves. Assessment of the quality of amplified sound, on the basis of the relationship of regenerative reverberation to the actual, and the distribution of energy level in the building are also dealt with. W. W. GEHR

534.84 : 778.5

5657. Architectural acoustics in cinematography. A. N. KACHEROVICH. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 6) 645–53 (1949) *In Russian.*

Brief discussion of questions on reverberation in film studios, sound theatres and ciné-auditoria and the present-day methods of damping arrangements. W. W. GEHR

534.843

5658. Frequency response fluctuations in rooms. R. H. BOLT AND R. W. ROOP. *J. Acoust. Soc. Amer.*, **22**, 280–9 (*March*, 1950).

534.845

5659. On the absorption of sound by suspended porous materials in a room. C. M. HARRIS. Letter in *J. Acoust. Soc. Amer.*, **22**, 290–1 (*March*, 1950).

534.85 : 621.395.625.3

5660. Soviet designs of apparatus for magnetic sound recording. I. E. GORON. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 6) 662–5 (1949) *In Russian.*

OPTICS . RADIATION . SPECTRA 535

535.214.4

5661. The membrane radiometer. P.-E. WEBER. *Optik*, **6**, 152–61 (*March*, 1950). Erratum: *ibid.*, 255 (*April*, 1950) *In German.*

An i.r. radiation pick-up depending on the gas kinetic effect. A membrane of duralumin foil, 2·5 cm diameter and 8 microns thick, forming one side of a gas enclosure, is set in vibration by the

ıcident modulated radiation, and the vibrations roduce capacitance variations in a tuned high equency bridge. The window was of KRS5. hermal modulation in general is considered ieoretically, and in particular for the membrane ıdiometer for which a relationship for the power f the absorbed radiation as a function of, *inter alia*, ıe radiometer dimensions and of the frequency of ıodulation is derived. $1{\cdot}2\ \mathrm{W\,cm^{-2}}$ could be etected using a modulation frequency of 100 c/s. he author's measurements using the membrane adiometer agree with those obtained by R. chneiderreit [*Z. tech. Phys.*, **23**, 208 (1942)] suitably ecalculated. S. WEINTROUB

535.214.6

5662. Photophoresis and a property of solar light in ausing a rotation of matter in a vacuum. F. EHRENHAFT AND E. REEGER. *C.R. Acad. Sci., Paris*, **230**, 38–40 (*March* 6, 1950) *In French.*

Particles of silver, graphite, or glass, in air at ressures $\sim 5{\cdot}10^{-6}$ mm Hg continue in helical rajectories for several hours; the axis of the helix is he direction of the incident light. Reduction of the ight intensity moves the trajectory nearer the focus, ventually causing instability. N. CORCORAN

535.214.6

5663. Comments on the preceding communication. A. COTTON. *C.R. Acad. Sci., Paris*, **230**, 940 (*March* 6, 1950) *In French.*

The experimental results of Ehrenhaft and Reeger ıgree with those of Tauzin and Whytlaw–Gray, but he interpretation placed on them is different. N. CORCORAN

535.22

5664. A new method for the measurement of the velocity of light. A. AMERIO. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **2**, 238–43 (*March*, 1947) *In Italian.*

A variation of the Kerr cell method, in which the cells are at a considerable distance and the oscillating potential is conveyed to them by radio waves. L. PINCHERLE

535.23.08

5665. The basic principles of the efficiency of radiation-measuring instruments. G. EICHORN AND G. HETTNER. *Ann. Phys., Lpz.* (*Folge* 6) **3**, 120–3 (1948) *In German.*

A discussion of the limits of performance of thermal and electromagnetic radiation detection instruments on the basis of radiation theory. T. C. TOYE

535.24

5666. Note on the brightness profile and photometric contrast of a test-object having small angular dimensions and silhouetted against the twilight sky. D. R. BARBER. *Proc. Phys. Soc. Lond. B*, **63**, 364–9 (*May* 6, 1950).

Microphotometry of photographs of distant objects with small angular subtense has shown that inaccurate results are obtained if the apparent contrast is calculated on the assumption of uniform sky brightness. No evidence was found of any edge effect due to inward small angle scatter. A.

535.247

5667. The use of the automatic-equalising photometer in measurement and control. J. SCHOEN. *Arch. tech. Messen, Issue* 170 (*Ref. V*462–1) T25–26 (*March*, 1950) *In German.*

The basic system contains 2 beams of light, a light modulating shutter, photocell and a.c. amplifier. When one beam varies in intensity, the rectified output applied to a servo motor brings the 2 beams back to equality. Errors in practice are shown to be $< 1\%$. A number of uses in technology are described, IR spectrographs, colorimeters, densitometers, the control of liquid mixtures, computing mechanisms, curve followers, etc. R. W. FISH

535.247.4

5668. Report on the preparation of the glasses for the photocell correction filter. D. G. ANDERSON. *J. Sci. Instrum.*, **27**, 131–2 (*May*, 1950).

An indication is given of the special nature of the glasses used as components in the correction filters for barrier-layer Se photocells and the special problems of production are discussed. A.

535.247.4

5669. A three-component glass filter to correct the spectral sensitivity curves of selenium rectifier photoelectric cells to that of the eye for photopic vision. H. G. W. HARDING. *J. Sci. Instrum.*, **27**, 132–4 (*May*, 1950).

The spectral sensitivity curves for 3 makes of British cell are given. The filter consists of a light yellow, a dark yellow and a blue-green glass cemented together with Canada balsam. The glass types and the correction obtained are described. A.

535.247.4

5670. The relative spectral response of the selenium rectifier photocell in relation to photometry and the design of spectral correction filters. J. S. PRESTON. *J. Sci. Instrum.*, **27**, 135–9 (*May*, 1950).

See preceding 2 Abstr. Discusses the difficulties associated with measurements of the spectral response of Se cells, the variability of the results among different cells, and among cells of different British makes, and likely future tendencies. Tables of relative spectral response of a number of cells are given. A.

535.314

5671. Optical refraction and Fermat's principle at a point. R. SCHLEGEL. *J. Opt. Soc. Amer.*, **40**, 244–5 (*April*, 1950).

The law of refraction of light rays is derived from Fermat's principle by means of the Weierstrass–Erdmann corner condition of the calculus of variations. In such a derivation the optical path need only be considered at the point of refraction, and the refraction principle follows from a differential equation rather than from an integral equation or geometric construction for a finite length of path. Likewise, the corner condition taken with Fermat's principle is a differential equation which requires that an optical path be straight at all points where the velocity is unchanged. A.

535.316

5672. Matrices and the theory of optical instruments. II. Thin lenses and their aberrations. T. SMITH. *An. Real Soc. Esp. Fis. y Quim.*, **45A**, 391–406 (*Sept.–Oct.*, 1949) *In Spanish.*

535.317 : 535.245.24

5673. The distribution of light from optical systems. W. H. STEEL. *Aust. J. Sci. Res. A*, **53**, 335–53 (*Sept.*, 1949).

A geometrical method is developed for calculating the distribution of intensity with angle of the light leaving an optical system, when the angle at which a ray from a point on the optical axis leaves the system is known as a function of the aperture. The case of a point source on the axis of the system is treated exactly, and an approximation is given for that of a small finite source; the method is applicable to systems with spherical aberration. The distribution of illumination across any plane normal to the axis is treated by analogous methods. The results are compared with measurements of the light distribution from an optical system possessing considerable spherical aberration. A.

535.317 : 535.8 : 513.76

5674. Instrumental-optics. J. ROSENHAGEN. *Optik*, **6**, 162–79 (*March*, 1950) *In German.*

This branch of optics deals with the path of a principal ray through an optical instrument or through a single optical element having plane surfaces (prisms). The theory finds the alteration of the ray direction caused by rotation of the instrument or by reflection and refraction at the plane surfaces. The instrumental sphere of unit radius is constructed, and all rays, optical axes and surface normals are made to pass through its centre by translations. Their intersections with the unit sphere then define the rays, etc., in terms of the spherical or Cartesian co-ordinates of the point of intersection. In passage through the instrument, these components undergo linear transformations which can be computed by the help of matrix calculus. R. W. FISH

535.317.25

5675. The theory of image formation in the microscope. M. BEREK. *Optik*, **6** (*No.* 1) 1–7 (1950) *In German.*

Earlier results [Abstr. 3908 (1950)] are applied to the microscope image of the fine structure of the diatom *Pleurosigma angulatum*. The individual cells are shown to be imaged as a grating if only two diffraction maxima, or as separate units if three diffraction maxima, fall within the aperture of the objective. The resolving power with bright ground illumination is obtained as a function of the illuminating aperture and experimental measurements are shown to confirm this theoretical value. For dark ground illumination, experiment shows the resolving power to be independent of the illuminating aperture probably because of scattering within the diatom itself, causing it to act as a self-luminous body.

R. W. FISH

535.317.25

5676. The resolving power of a coated objective. II. J. E. WILKINS, JR. *J. Opt. Soc. Amer.*, **40**, 222–4 (*April*, 1950).

The diffraction pattern produced by an objective may be altered by applying coats to its exit pupil. If a coating is applied in such a manner as to reduce the diameter of the central bright disc, the central maximum intensity of the diffraction pattern is reduced. In this paper that diffraction pattern which has the highest central maximum intensity is shown for each fixed diameter of the central bright disc. The coating producing this diffraction pattern is such as to make the central zone of the exit pupil out of phase by one-half wavelength with the rest of the exit pupil, the size of the central zone being determined by the diameter of the central bright disc. A.

535.317.5

5677. Optical systems with central symmetry and their application. A. COLACEVICH. *Ossvz. Mem. Oss. Astr. Arcetri* (*No.* 64) 51–61 (1948) *In Italian.*

The theory of the 3rd order (primary) spherical aberration is given for concentric optical systems employing both reflecting and refracting surfaces. The results are applied to systems using (*a*) a single spherical reflecting surface and one or more thin meniscus correcting lenses, or (*b*) 2 spherical reflecting surfaces formed on a block of glass. The former are similar to Schmidt telescopes in many characteristics and calculation shows that they may be constructed up to 40 cm in diameter at $f/2{\cdot}5$. Instruments of the second type are suited to shorter focals below 50 mm with aperture ratios up to $f/0{\cdot}5$.

R. W. FISH

535.317.5

5678. A generalisation of the formula due to Kerber. F. TEMMERMAN. *Rev. Opt.* (*Théor. Instrum.*) **29**, 195–9 (*April*, 1950) *In French.*

The formula of Kerber, for the calculation of spherical aberration by finite differences, is put into a more general form. It then allows the calculation of the co-ordinates of any meridional ray whatsoever by finite difference equations suitable for computation. Formulae, similar to those of Staeble, are simply derived, allowing computation of the departure from the sine condition as a sum of terms arising at each surface. R. W. FISH

535.321 : 535.55

5679. A new method of measurement of the variation with wavelength of the refractive index and absolute stress optical coefficients of amorphous solids. J. E. H. BRAYBON. *Proc. Phys. Soc., Lond. B*, **63**, 446–51 (*June*, 1950).

White light is passed through a Michelson interferometer in one of whose arms a thin lamina of the substance in the shape of a tension member is supported by a loading frame. The emergent beam, examined by a spectrometer, shows a continuous spectrum crossed by interference fringes. For the unstressed lamina the position of the fringes gives the variation of refractive index with wavelength. For the stressed lamina the behaviour of the fringes gives the stress optical coefficients. No modification of the interferometer, and only 3 sets of observations on the fringes, are required. For the calculation of absolute values of the refractive index the values of 2 wavelengths must be known. Full details of the method are given, and photographs of tests on Columbia Resin 39 are included. These show that CR39 becomes positively birefringent under tension.

A.

535.33 : 536.46

Spectroscopic studies of low-pressure flames. *See str.* 5776–7

535.33.072

30. The doubling of dispersive systems in the erior of spectrographs. P. SWINGS. *Bull. Soc. Roy. ., Liège*, **19**, 97–106 (*Feb.*, 1950) *In French.*

Several dispersive systems may be combined within framework of a single spectrograph so as to cover arge spectral region with adequate linear dispersion a single exposure. A single slit is used, and a beam itter divides the light between two or more optical tems. The method is applicable to all types of ctrograph; it is described for some concave grating, ne grating and prism instruments. A. G. GAYDON

535.33.072

31. A ratio-recording double beam infra-red ctrophotometer using phase discrimination and a gle detector. A. SAVITZKY AND R. S. HALFORD. *v. Sci. Instrum.*, **21**, 203–12 (*March*, 1950).

A simple modification is described for converting a rkin–Elmer infrared spectrophotometer to double am operation for direct recording of percent transssion *v.* wavelength. A phase discrimination system sed, requiring no changes in the optical system, and sacrifice of versatility or ease of prism interchange. complete spectrum over the rocksalt region may be tained in 25 min with good resolution, and with no ention from an operator. Samples as small as 6 mm can be studied. The system is readily aptable to other spectrophotometers, including se in the visual and u.v. range, the only limitation ing sufficiently rapid response by the detector. A.

535.331

32. On Araki's theory of inverted alkali doublets. Y. WU. *J. Phys. Soc. Japan*, **4**, 343–5 (*July–c.*, 1949).

The explanation of Araki [*Proc. Phys. Math. Soc. pan*, **21**, 508 (1939)] that the inversion of doublets certain alkali spectra is due to the spin-orbit eractions between the valence electron and the core ctrons has been examined more closely. It is nd that his good agreement between theory and servation is the result of unjustified approximations d that the proposed interactions are entirely dequate for the explanation of the observed ersion. A.

535.331

33. A remark on Ta-You Wu's criticism on the ory of inverted alkali doublets. G. ARAKI. *J. Phys. c. Japan*, **4**, 345–7 (*July–Dec.*, 1949).

535.331

34. Wave-lengths of the potassium lines 3446A d 3447A. A. ROMER, R. D. TURNER AND I. C. EHLI. Letter in *J. Opt. Soc. Amer.*, **40**, 178 (*March*, 50).

535.334 : 535.338.3 : 523.77

35. Forbidden lines of sodium in the solar spectrum. RIGHINI AND M. L. CATANI. *Atti Accad. Naz. ncei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **1**, 374–7 (*March–ril*, 1946) *In Italian.*

Considerations both of intensity and of the effect electric fields upon their excitation make it most probable that 3^2P–4^2F lines of Na I for which the laboratory wavelengths are $5\,675{\cdot}674 \pm 0{\cdot}036$ and $5\,670{\cdot}062 \pm 0{\cdot}009$ Å, are to be identified with the solar lines at $5\,675{\cdot}733$ and $5\,670{\cdot}152$ Å.

R. F. BARROW

535.338

5686. The wave statistical theory of complex spectra. S. SENGUPTA. *Indian J. Phys.*, **23**, 547–66 (*Dec.*, 1949).

Wave statistical representation of spin developed in two earlier papers of Kar-Sengupta [Abstr. 5330 (1949)] and Sengupta [Abstr. 2332 (1950)] are applied to the case of complex spectra. General formulae for the energy levels in the *sl* configuration are obtained. These formulae are the same as those obtained previously by Houston. For *pl*-configuration, general formulae have been derived for the first time for the two limiting cases of *LS* and *jj* coupling. Applying the same method in the case of *N* electrons in any configuration, the well-known Γ- and *g*-sum rules for the multiplets are derived. In addition, a new sum rule applicable to the electrostatic interaction energy has also been obtained. It has been called the *δ*-sum rule. The rule has been verified by taking the experimental results for a number of elements. A.

535.338.333

5687. Isotope displacement in the spectrum of cerium. P. BRIX AND H. FRANK. *Z. Phys.*, **127** (*No.* 3) 289–96 (1950) *In German.*

Hyperfine structure measurements are made on lines in the Ce II spectrum lying between λλ4450–4750. The source used is a liquid-air-cooled hollow-cathode discharge and structures were studied with a Fabry–Perot interferometer. Isotope displacement for the 140, 142 isotopes (ratio 8 : 1) is reported for 9 lines. An average value of $0{\cdot}054\ \text{cm}^{-1}$ is derived, with the heavier isotope line to the red. Between Ba and Ce the size of the isotope displacement increases by a factor of 2. This appears to be associated with the "magic" number of neutrons, 82. S. TOLANSKY

535.338.334 : 538.615

5688. Magnetic enhancement of spectral lines from ions, with an application to the Th IV-spectrum. P. F. A. KLINKENBERG. *Physica*, **16**, 185–97 (*March*, 1950).

It is shown that the tentative term $8\ ^2P$ in the Th IV spectrum given previously, is correct. The wave-lengths of the combinations with lower terms are accurately measured and the relative level values improved. The observed Zeeman patterns agree with theoretical anticipation within experimental error, assuming normal *g*-values. The *σ*-splitting of λ6901 ($5\ ^3F_{5/2}$–$6\ ^2D_{5/2}$) is determined more accurately than before. A few data concerning the spectrum of U VI are predicted from the iso-electronic sequence Ra II–Th IV–U VI. A description and qualitative explanation of the phenomenon of the magnetic enhancement of lines in ion spectra is given. A.

535.338.4

5689. The complex band spectrum of columbium oxide (the diatomic molecule CbO). V. RAMAKRISHNA RAO. *Indian J. Phys.*, **24**, 35–49 (*Jan.*, 1950).

An extensive band system attributable to the diatomic molecule CbO is obtained in the region from λ4200 to the limit of sensitivity of the panchromatic plates used. Vibrational constants are

determined for the three systems found. Evidence of multiplet structure is found and electronic transitions between quartet terms are suggested as probable. A.

535.338.4

5690. Singlet electronic states of the TiO molecule. J. G. PHILLIPS. *Astrophys. J.*, **111**, 314–27 (*March*, 1950).

Rotational analyses of the bands in the spectrum of the TiO molecule at 8 859 and 5 597 Å have made it possible to identify the corresponding electronic transitions as $^1\Pi$–$^1\Delta$ and $^1\Phi$–$^1\Delta$, respectively. The two transitions have a common lower state. The resulting rotational constants are presented in a table. It is shown that the two bands are the (0–0) bands of the respective systems. Additional bands of the two systems are listed. The excitation energies, ν_{00}, of the $^1\Pi$- and $^1\Phi$-states are 11 272·77 and 17 840·60 cm^{-1}, above the $^1\Delta$-state, respectively. A.

535.338.4

5691. Bands of ZrF. M. AFAF. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 544–5 (*May*, 1950).

535.338.4

5692. The Schumann–Runge O_2 emission bands in the region 3 100 A–2 500 A. M. W. FEAST. *Proc. Phys. Soc., Lond. A*, **63**, 549–56 (*June*, 1950).

Rotational and vibrational analyses of the emission Schumann–Runge O_2 bands in the region 3 100 Å to 2 500 Å are presented. Tables of wave numbers are given for the (1, 12), (0, 11), (1, 11), (0, 10), (1, 10), (1, 9), (2, 9), (1, 8), (2, 8), (2, 7) bands. The origins of the bands, the rotational differences, and constants for the levels $v'' = 7$ to 11 are given. Three bands, found in a high voltage arc in O between Pt electrodes, are attributed to PtO. A.

535.338.4

5693. New O_2^+ second negative bands: a note on O_3 and O II emission spectra. M. W. FEAST. *Proc. Phys. Soc., Lond. A*, **63**, 557–63 (*June*, 1950).

The spectrum of an electrodeless discharge in pure O has been studied. New bands of the O_2^+ second negative system have been found and the intensity distribution in this system is discussed; subsidiary parabolae as well as the main Franck–Condon parabola are obtained as is predicted by the theory. Emission bands reported by Johnson as due to O_3 are due to O_2^+ and O II. Some abnormal intensities of O II lines excited in the electrodeless discharge are noted. The electrostatic and electromagnetic types of excitation are briefly compared. A.

535.338.4

5694. The spectra emitted by the high voltage arc in nitrogen, hydrogen, nitrogen–hydrogen mixtures and ammonia. M. W. FEAST. *Proc. Phys. Soc., Lond. A*, **63**, 563–7 (*June*, 1950).

The spectra emitted by the high voltage arc in N_2, H_2, H_2–N_2 mixtures and NH_3 have been studied. The appearance of the N_2 second positive bands at various N_2 gas pressures is discussed and the divergence of rotational and vibrational temperatures is noted. Traces of O_2 greatly reduce the strength of the N_+ bands emitted by the arc in N_2. In N_2–H_2 mixtures the NH 3 360 Å band is found to be emitted strongly only when H_2 is present at a very low partial pressure. An attempt is made to explain the various observations.

535.338.4 : 537.

5695. Rotational analysis of the (1, 0) band of t N_2 first positive system. M. W. FEAST. *Proc. Phy Soc., Lond. A*, **63**, 568–74 (*June*, 1950).

The (1, 0) band of the N_2 first positive system h been photographed at a dispersion of abo 1·2 cm^{-1}/mm. The wave numbers and quantu numbers of the lines, and the rotational ter differences in the upper and lower states are give The spin tripling in the $^3\Sigma$ state and the Λ doubli in the $^3\Pi$ state are evaluated.

535.341 : 536.521 : 536.4

Determination of the absorption coefficients of so particles from various flames. *See Abstr.* 5778

535.343

5696. Thermal displacement of the long wav length edge of the lattice absorption of cadmiu sulphide. R. SEIWERT. *Ann. Phys., Lpz.*, **6**, 241– (1949) *In German.*

See also Abstr. 4838 (1950). The method obtaining absorption curves of artificially prepar CdS crystals, between the temperatures of 290°K ar 980°K and in the wavelength range 5 000 Å to 6 500 is described. The temperature displacement of th long wavelength edge, obtained by producing th approximately straight portions of the curves, w found to be between 1·4 and 2·3 Å per degree. part this is due to a change in lattice constant an Möglich and Rompe's theory of this effect [Abst 2148 (1944)] involves the coefficient of expansio Its measurement is described by the present autho (mean value $5{\cdot}7 \times 10^{-6}$ per degree) and Möglich an Rompe's theory is found to be insufficient to accou for the whole displacement. Additional displac ments due to collision broadening and impurities a also discussed. P. T. LANDSBER

535.343.2 : 535.3

5697. The absorption spectra of manganese fluorid zinc fluoride, and manganese-activated zinc fluorid W. W. PARKINSON, JR. AND F. E. WILLIAMS. *J. Chem Phys.*, **18**, 534–5 (*April*, 1950).

Thin films of MnF_2, ZnF_2 and ZnF_2 : Mn hav been prepared by evaporation, and their optica absorption spectra have been measured from 1 50 to 2 600 Å. The absorption coefficient of MnF_2 ha a maximum of $8{\cdot}64 \times 10^4$ cm^{-1} at 1 613 Å, corre sponding to an oscillator strength of 0·042; whil there appears to be a maximum of lower value a 1 470 Å for ZnF_2. An unresolved weaker band a 2 050 Å is also evident for MnF_2. For the phosphor ZnF_2 : Mn, the absorption coefficient is intermediat between those of ZnF_2 and MnF_2, but the peak characteristic of the Mn^{++} activator is shifted to 1 666 Å and the oscillator strength of the transition is increased to 1·2. The relative excitation spectrum of ZnF_2 : Mn was determined, and maximum response occurred between 1 600 and 1 670 Å, indicating that radiation in the strong absorption band characteristic of the activator is most effective in exciting luminescence. Less efficient excitation occurs to 2 200 Å. It is concluded that a transition to an excited atomic state of the activator, rather than an electron transfer

ocess, is responsible for the first absorption peaks MnF_2 and ZnF_2 : Mn. A.

535.343.2 : 548.7

98. The vibrational spectra of molecules and mplex ions in crystals. III. Ammonium chloride and utero-ammonium chloride. E. L. WAGNER AND F. HORNIG. *J. Chem. Phys.*, **18**, 296–304 (*March*, 50).

The i.r. spectra of thin non-scattering films of H_4Cl and ND_4Cl were obtained at 28°, −78° and 190°c. A convenient low temperature transmission pe cell usable for such films is described. No dication of fine structure due to free rotation of the H_4^+ ions was found. Instead, evidence is presented r the existence, both above and below the λ-point, a torsional lattice mode involving the NH_4^+ ions. ıe limiting frequencies of the torsional oscillations ere observed at about 390 and 280 cm^{-1} for NH_4Cl ıd ND_4Cl, respectively. These values agree quite ell with the frequencies calculated on the basis of a irely electrostatic potential function. The spectra the low temperature modifications indicate strongly at the structures belong to the space group T_d^1 in nich the NH_4^+ ion symmetry is T_d. Of the 8 bserved bands, 2 are assigned to the triply degenerate ndamentals ν_3 and ν_4, one to the overtone $2\nu_4$, ıe to the combination $\nu_2 + \nu_4$ which resonates rongly with ν_3, one to the combination of the totally mmetric mode, ν_1, with the limiting lattice fre- ıency, ν_5, and 2 to the combinations involving the ttice torsional mode, ν_6, i.e. $\nu_4 + \nu_6$ and $\nu_2 + \nu_6$. ıe spectra of the room temperature modifications e consistent with a structure in which the NH_4^+ n tetrahedra are randomly distributed between e two possible equilibrium orientations in each nit cell. The λ-point transformations are probably mple order-disorder transitions between the two odifications. A.

535.343.2 : 548.7

99. The vibrational spectra of molecules and mplex ions in crystals. IV. Ammonium bromide nd deutero-ammonium bromide. E. L. WAGNER AND . F. HORNIG. *J. Chem. Phys.*, **18**, 305–12 (*March*, 50).

The infrared spectra of thin non-scattering films of H_4Br and ND_4Br were obtained at 28°c, −78°c nd −190°c. The spectra of both compounds in hase III are in agreement with the X-ray symmetry T_h^7. The torsional oscillation frequencies occur at 9 cm^{-1} and 230 cm^{-1} in NH_4Br and ND_4Br, spectively. The spectra of Phase II are similar to ose of the chloride and indicate a structure in which e NH_4^+ ions are disordered in their equilibrium ientations. There is no evidence of free rotation at ıy temperature studied. The spectra support X-ray idence for a further transition at −100°c in ND_4Br Phase IV which has symmetry T_d^1 as in NH_4Cl. A.

535.343.3–15 : 535.375.5

00. Substituted methanes. I. Raman and infra-red ectral data, assignments, and force constants for some ibromomethanes. A. G. MEISTER, S. E. ROSSER AND F. CLEVELAND. *J. Chem. Phys.*, **18**, 346–54 *Aarch*, 1950).

Raman displacements, semiquantitative relative intensities, quantitative depolarization factors, and i.r. absorption frequencies in the region 700–5 000 cm^{-1} have been obtained for CBr_3H, CBr_3Cl and CBr_4. Details about the design of the i.r. spectrograph are given. The Raman and i.r. spectral data in the literature for CBr_3H, CBr_3D, CBr_3F, CBr_3Cl, and CBr_4 have been critically examined in comparison with the present results and a decision made as to the probable values of the data. Assignments of the observed Raman and i.r. bands, consistent with the selection rules, were made and force constants were calculated, using a potential energy function containing all possible second degree terms. A.

535.343.32

5701. The absorption spectra of hydrated ions. A. KISS AND C. SÁNDORFY. *Rev. Sci., Paris*, **87**, 37–41 (*Jan.–March*, 1949) *In French.*

A review, giving extinction coefficient/wave-number curves (15 000–50 000 cm^{-1}) for aqueous solutions of 29 perchlorates. R. F. BARROW

535.343.32

5702. The effect of the electrostatic polarization of the solvent on electronic absorption spectra in solution. N. S. BAYLISS. *J. Chem. Phys.*, **18**, 292–6 (*March*, 1950).

535.343.32–31

5703. Near ultraviolet absorption spectra of melamine and some related compounds. G. W. COSTA, R. C. HIRT AND D. J. SALLEY. *J. Chem. Phys.*, **18**, 434–7 (*April*, 1950).

An absorption band of low intensity has been found in the 2 800 to 3 400 Å region for solutions of melamine, trimethylol melamine, trimethyl ether of trimethylol melamine, hexamethylol melamine and cyanuric chloride. The band has also been observed in gaseous melamine at elevated temperatures. The band is believed to be due to a singlet-triplet transition, rather than analogous to the 2 600 Å absorption system of benzene. A.

535.343.4–14

5704. The microwave spectra of isotopic methyl chloride. G. MATLACK, G. GLOCKLER, D. R. BIANCO AND A. ROBERTS. *J. Chem. Phys.*, **18**, 332–4 (*March*, 1950).

The rotational transition $J = 0 \rightarrow J = 1$ of the isotopic species $C^{13}H_3Cl$, $C^{12}H_2DCl$ and $C^{12}HD_2Cl$ have been investigated by microwave absorption. The data have been used to obtain the ground state dimensions of the methyl chloride molecule. A.

535.343.4–14

5705. The inversion spectra of NH_3, CH_3Cl and CH_3Br at high pressures. B. BLEANEY AND J. H. N. LOUBSER. *Proc. Phys. Soc., Lond. A*, **63**, 483–93 (*May*, 1950).

The absorption due to the inversion spectrum of NH_3 has been studied at pressures up to 6 atmos. between wavelengths of 8 cm and 8 mm. The resonant frequency is found to shift downwards from 0·78 cm^{-1} as the pressure rises, becoming substantially zero above 2 atmos. The line width rises less rapidly than the pressure in the transition region, but ultimately ∝ the pressure with an effective "collision diameter" of 7·7 Å. These effects are attributed to multiple collisions, which become

dominant at the higher pressures; the resonant inversion is then destroyed by the molecular interaction. In the methyl halides the inversion frequency is virtually zero owing to the low probability of tunnelling through the barrier, but the absorption line is spread out to the centimetre wave region by the collision process. The collision diameters are found to be 7·7 Å and 9·0 Å for methyl chloride and bromide respectively. A.

535.343.4–14 : 535.338.334

5706. The pressure broadening of the vibration rotation band of the HCN molecule at 10 380 A. G. Kortüm and H. Verleger. *Proc. Phys. Soc., Lond. A*, **63**, 462–9 (*May*, 1950).

The relation between the line-width of the 0–3 vibration-rotation band of HCN at 10 380 Å and the pressure of the HCN gas, as well as the pressure resulting from the addition of different extraneous gases, was investigated. In the *P* and *R* branches of the band a relation was found between the half-line width and the rotational quantum number, *J*, which differs for the broadening due to self-pressure and the broadening resulting from pressure of extraneous gases. The results could be explained, according to London's theory, in the former case as an effect due to the combined action of rotational resonance alignment, and in the latter case to alignment alone. Measurements made with the addition of DCN suggest that the chain association of the hydrogen bridge bonds also has an effect on the half-width value. A.

535.343.4–15 : 535.375.5

5707. Infra-red and Raman spectra of fluorinated ethylenes. I. 1,1-difluoroethylene. D. C. Smith, J. R. Nielsen and H. H. Claassen. *J. Chem. Phys.*, **18**, 326–31 (*March*, 1950).

The i.r. absorption of $CF_2 : CH_2$ gas has been investigated between 2 and 22·7 μ with a prism spectrometer of high resolution. The Raman spectrum of the compound in the gaseous state has been photographed with a 3-prism glass spectrograph of linear dispersion 15 Å/mm at 4 358 Å. The 12 fundamental vibration frequencies have been assigned and the observed spectra have been interpreted in detail. A.

535.343.4–15 : 535.375.5

5708. Infra-red and Raman spectra of fluorinated ethylenes. II. 1,1-difluoro-2,2-dichloroethylene. J. R. Nielsen, H. H. Claassen and D. C. Smith. *J. Chem. Phys.*, **18**, 485–9 (*April*, 1950).

The infrared absorption spectrum between 2 and 22·6 μ has been investigated with a prism spectrometer of high resolution. The Raman spectrum of $CF_2 : CCl_2$ in the liquid state has been photographed with a three-prism glass spectrograph of linear dispersion 15 Å/mm at 4 358 Å. Quantitative polarization measurements have been made. The 12 fundamental vibration frequencies have been assigned and the observed vibration spectra have been interpreted in detail. A.

535.343.4–15 : 539.133

5709. The vibration–rotation bands of the hydrogen halides HF, $H^{35}Cl$, $H^{37}Cl$, $H^{79}Br$, $H^{81}Br$ and $H^{127}I$. S. M. Naudé and H. Verleger. *Proc. Phys. Soc. Lond. A*, **63**, 470–7 (*May*, 1950).

The 2–0, 3–0 and 4–0 bands of HF^{19}, the 4–0 ba 5–0 bands of HCl^{35} and HCl^{37}, the 4–0 band HBr^{79} and HBr^{81}, and the 4–0 band of HI^{127} we photographed under great dispersion in the infrare The molecular constants have been calculated a are summarized in a table.

535.343.4–

5710. The far ultra-violet absorption spectra of t hydrides and deuterides of sulphur, selenium a tellurium and of the methyl derivatives of hydrog sulphide. W. C. Price, J. P. Teegan and A. Walsh. *Proc. Roy. Soc. A*, **201**, 600–9 (*May* 2 1950).

The absorption spectra in the vacuum u.v. of t hydrides and deuterides of S, Se and Te, and meth mercaptan and dimethyl sulphide are describe Well-developed Rydberg series leading to the follo ing ionization potentials have been found: H_2 10·47 V; MeSH, 9·44 V; H_2Se, 9·88 V; H_2T 9·14 V. In the case of one series for H_2Se members of the series were observed. The spect of the deuterides are almost identical with those the hydrides, showing that virtually every band the spectra is due to a separate electronic transitio This and the general nature of the rotational fi structure show the transitions concerned to be thos of an electron from a non-bonding ground-sta orbital, i.e. from the *p* lone-pair ground-state orbita The nature of the upper orbitals of the various serie is also interpreted and shown to provide explanation of certain peculiarities of the observations. Th quantity $I(X) - I(H_2X)$, where X is a group V element, or $I(Y) - I(HY)$, where Y is a group VII element, is shown to be +ve and comparativel large when X or Y lies in the first period of th periodic table, but to change sign and to remai almost constant at a small −ve value as one passe to elements in later periods. A plot of $I(H_2X)$ agains the first ionization potential of the correspondin inert gas is linear. Extrapolation enables the firs ionization potential of H_2Po to be predicted a 8·6 V. A similar plot for the halogen acids, i assumed linear, yields a predicted first ionizatio potential for HF of 17·0 ± 0·7 V. A

535.345–31 : 614.485

5711. Transmission of bactericidal radiation through glass. J. E. Stanworth. Letter in *Nature, Lond.* **165**, 724–5 (*May* 6, 1950).

535.345.6 : 535.39 : 771.534.53

5712. Note on the employment of step filters for determining sensitometric curves. L. d'Or and G Pirlot. *Bull. Soc. Roy. Sci. Liège*, **18**, 108–12 (*March*, 1949) *In French*.

An advantage of the method is its freedom from error due to source fluctuation. For obtaining suitable thin metal films to act as neutral absorbing filters for microphotometer densitometry, absorption measurements are made with films of Sb, Pt, Bi, Al, Ag for the region 2 000 to 7 000 Å. The metals are deposited by vacuum evaporation on to quartz. The curves obtained are not quite reproducible, as is shown by 3 separate Sb curves. Sb appears to be a

itable material for a neutral filter and the films are fficiently stable. S. TOLANSKY

535.347–15 : 539.13 : 541.57

713. Near infra-red pleochroism. I. The perturbed —H and the C—H modes in polyvinyl alcohol. Glatt, D. S. Webber, C. Seaman and J. W. Ellis. *Chem. Phys.*, **18**, 413–16 (*April*, 1950).

Pleochroism in O—H . . . O—H bands and CH_2 bands of polyvinyl alcohol is studied in the ·6–3·7 μ-region, using a quartz recording spectrograph in the 0·6–2·7 μ-region and a high dispersion ating instrument with a Se polarizer in the 2·5–·7 μ-region. Weak pleochroism in the fundamental O—H) bands suggested that either some of the onclusions drawn from X-ray determinations may e in error or that there may be appreciable departure f the positions of the H atoms from the O—O lines.)ichroic bands caused by bound water are also found this region, complicating interpretation and erhaps explaining discrepancies between this work nd that of Elliott, Ambrose and Temple. Evidence presented for the presence of "free" carbinol)—H units in the crystalline regions of well-dried pecimens. Pleochroic bands at 2 941 cm^{-1} and 906 cm^{-1} are tentatively assigned to $> CH_2$ ν_a and fundamentals respectively. A.

535.37

714. Emission and absorption of light in a system f inductively linked molecules. S. I. Vavilov and M. D. Galanin. *Dokl. Akad. Nauk, SSSR*, **67** *No.* 5) 811–18 (1949) *In Russian.*

The usual assumption (*a*) $r \gg \lambda$ (r = distance etween emitting and absorbing molecules, λ = ength of the corresponding light-wave) is inapplicable o a medium which simultaneously luminesces and bsorbs. The case (*b*) $r \ll \lambda$ is therefore examined, vith conclusions: (i) if under (*a*) the decreasing ntensity is selective, then under (*b*) the selectivity anishes and absorption becomes extinction, with ntermediate stages existing; (ii) a migration of xcitation energy between molecules occurs. Comparison with experimental data shows that the xtinction is the more complete the greater is the uperposition of the emission spectrum of the luorescing medium and the absorption spectrum of he extinctor molecules. The extinction runs parallel o the shortening of the luminescence time.

J. JACOBS

535.37

715. Some new infra-red phosphors. D. W. yon and E. L. Poore. Letter in *J. Opt. Soc. Amer.*, **0**, 179–80 (*March*, 1950).

A number of new infrared-sensitive phosphors ormed by combinations of ZnO, CdO or MgO with ore acidic oxides of Al, As, B, Cb, Ge, Mo, Si, n, Ti, V, W and Zr are described. Nine different ctivator combinations using Mn, Sm, Ce and Pb re employed together with flux inclusions. Tables f qualitative data for 78 different preparations are iven for excitation by 1 850 Å, 2 537 Å and 3 650 Å adiation but no measurements of emission and timulation spectra have yet been made.

G. F. J. GARLICK

535.37

5716. Influence of the annealing temperature and of concentration of the activator on the law of temperature quenching of the luminescence of phosphors. F. I. Vergunas and F. F. Gavrilov. *J. Exp. Theor. Phys., USSR*, **20**, 224–32 (*March*, 1950) *In Russian.*

Temperature quenching of the blue and green bands of ZnS–Cu phosphors with a varying concentration of activator, but the same annealing temperature, and of phosphors with a constant activator concentration, but differing annealing temperatures were investigated. The dependence of the intensity of luminescence I on the intensity of the exciting light was investigated for the same bands. It is shown that this relation is comparable with the law of temperature quenching of the luminescence of the phosphor. B. F. KRAUS

535.37 : 538.22

Specific magnetic susceptibilities and related properties of manganese-activated zinc fluoride. *See Abstr.* 5959

535.37 : 539.26

5717. X-rays in the development of inorganic phosphors. H. P. Rooksby and A. H. McKeag. *G.E.C. J.*, **17**, 85–95 (*April*, 1950).

A survey of the use of X-ray methods in the development of phosphors such as borates, silicates, tungstates and halophosphates is given. Applications to phosphor identification, crystal perfection, role of impurity activator and effects of matrix lattice composition on fluorescence properties are described with X-ray powder photographs to illustrate them.

G. F. J. GARLICK

535.371

5718. Absolute output of the fluorescence of solutions of anthracene and some of its derivatives. F. I. Polovikov. *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 3) 453–6 (1950) *In Russian.*

535.371

5719. Influence of the medium on the fluorescence of organo-luminophores. B. Ya. Sveshnikov and A. A. Petrov. *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 3) 461–4 (1950) *In Russian.*

535.371

5720. Trivalent cations in fluorescent zinc sulphide. F. A. Kröger and J. Dikhoff. *Physica*, **16**, 297–316 (*March*, 1950).

Incorporation of monovalent cations in a lattice consisting of divalent ions is only possible to an appreciable extent when the lack of positive charge resulting from the substitution of a monovalent cation for a divalent one is compensated for. This compensation can be effected by a simultaneous incorporation of monovalent anions, or of cations of a valency higher than 2. On this basis it is explained that ZnS becomes fluorescent by the monovalent activators Ag^+, Cu^+, Au^+ and Zn^+ when halogens or trivalent cations are present. Some of the trivalent ions incorporated in this way are found to cause effects of their own (electron traps, fluorescence, killing of fluorescence due to the other centres). An atomic model of the centres of fluorescence is given. A.

535.371

5721. The physical chemistry of the formation of fluorescence centres in ZnS–Cu. F. A. KRÖGER AND N. W. SMIT. *Physica*, **16**, 317–28 (*March*, 1950).

On the basis of a model for the centres of fluorescence in ZnS–Cu arrived at in previous publications, the formation of centres with products prepared in controlled atmospheres of H_2S-HCl is discussed, assuming equilibrium to exist between the solid and the gas phase. A.

535.371

5722. A study of the mechanism of sensitized luminescence of solids. J. H. SCHULMAN, R. J. GINTHER AND C. C. KLICK. *J. Electrochem. Soc.*, **97**, 123–32 (*April*, 1950).

Reflection, excitation and emission spectra of $CaSiO_3$: (Pb) and $CaSiO_3$: (Pb + Mn) are reported, as well as measurements of the dependence of luminescence intensity on exciting intensity for $CaSiO_3$: (Pb + Mn) and NaCl : (Pb + Mn). It is shown that the data support the conventional concept of sensitization, where all the u.v. absorption is due to the sensitizer, and that Butler's picture, where the activator absorbs u.v., is invalid. An interpretation of the data on the $CaSiO_3$: (Pb + Mn) system is proposed, and the distance over which Pb^{+2} and Mn^{+2} interact in this phosphor is calculated on the basis of this interpretation. A.

535.371 : 536.48

5723. Fluorescence of benzene hydrocarbons at liquid oxygen temperature. B. A. PYATNITSKIĬ. *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 3) 457–60 (1950) *In Russian.*

535.372

5724. The variation of the absorption of the ZnS–Cu, Co-phosphor at excitation. V. V. ANTONOV-ROMANOVSKIĬ AND I. P. SHCHUKIN. *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 3) 445–6 (1950) *In Russian.*

See Anikina and Antonov-Romanovskiĭ [Abstr. 3077 (1950)]. An analogous investigation has been carried out with ZnS–Cu, Co-phosphor displaying a quenching (not a flashing-up) under the action of infrared light. It has been found that the spectral sensitivity of this phosphor with regard to quenching is directly connected with the spectral distribution of the supplementary absorption. F. LACHMAN

535.372

5725. Phosphorescence of phenanthrene vapours. P. P. DIKUN. *J. Exp. Theor. Phys., USSR*, **20**, 193–8 (*March*, 1950) *In Russian.*

The long duration of the luminescence of fluorene, carbazole, fluorenone and phenanthrene was observed. A detailed investigation of the phosphorescence of the latter substance showed that the mechanism of this effect corresponds exactly to a scheme with a metastable level. The dependence of the life-time of the excited state on temperature and pressure of the vapours was investigated, whereby the absence of quenching in the metastable state was found. Microphotograms of fluorescence and phosphorescence spectra and comparative curves of lifetime *v.* temperature and pressure are given. B. F. KRAUS

535.375.5

5726. The Raman spectrum of hexachlorodisilane. M. KATAYAMA, T. SIMANOUTI, Y. MORINO AND S. MIZUSHIMA. *J. Chem. Phys.*, **18**, 506–9 (*April* 1950).

The spectrum was observed in the liquid state and the normal vibrations of this molecule were calculated by use of the Urey–Bradley field. The 7 observed Raman frequencies could be assigned to the fundamental vibrations and the molecule was found to belong to the D'_{3h} symmetry. This means that the molecule exerts internal free rotation around the Si–Si bond as axis. This is in conformity with the experimental result of the electron diffraction investigation. A.

535.375.5

5727. The Raman spectrum of bromine. H. STAMMREICH. Letter in *Phys. Rev.*, **78**, 79–80 (*April* 1 1950).

535.375.5 : 548.0

5728. Raman spectra of single crystals of potassium hydrofluoride. J.-P. MATHIEU AND L. COUTURE-MATHIEU. *C.R. Acad. Sci., Paris*, **230**, 1054–6 (*March* 13, 1950) *In French.*

535.375.5 : 778.3

A single exposure photographic method for depolarization factor measurements. *See Abstr.* 6191

535.375.54 : 548.0

5729. Effect of temperature on the lifetime of fluorescence of solid acetone. W. E. KASKAN AND A. B. F. DUNCAN. *J. Chem. Phys.*, **18**, 432–4 (*April*, 1950).

The lifetime of fluorescence of solid acetone was found to be a function of temperature, and of an unknown parameter which was interpreted as the state of aggregation of the sample. Both of these effects were interpreted in terms of the exciton theory, in which a quantum of electronic excitation energy is capable of wandering through the crystal before it is emitted as light. A.

535.375.56

5730. Mean lifetime of the fluorescence of acetone and biacetyl vapors. W. E. KASKAN AND A. B. F. DUNCAN. *J. Chem. Phys.*, **18**, 427–31 (*April*, 1950).

The effects of pressure, temperature and exciting intensity on the lifetime of fluorescence of acetone and biacetyl vapour have been investigated. The pressure dependence of the lifetime in acetone was interpreted in terms of the formation of double molecules, and part of the temperature dependence was interpreted in terms of the formation of double molecules. The lifetime in biacetyl was found to be independent of pressure at a constant temperature, but dependent on temperature. The effect of oxygen on the lifetime in biacetyl was explained by assuming a simple Stern–Volmer mechanism for quenching. The lifetimes of fluorescence in both acetone and biacetyl were found to be dependent on the incident intensity. This effect was explained by assuming that the fluorescing molecules of both compounds were quenched by the products of photochemical decomposition. A.

535.376

31. The fluorescent excitation of solid and liquid phthalene, diphenyl and phenanthrene by α-particles, t electrons and γ-rays. L. HERFORTH AND H. ALLMANN. *Ann. Phys., Lpz.* (*Folge* 6) **4** (*No.* 5) 1–45 (1949) *In German.*

A continuation of earlier work [Abstr. 729, 3714, 15 (1948)]. The fluorescent emission of screens of phthalene (A) and diphenyl (B) made by sublimation is at ~3 800 Å, and of screens of compacted enanthrene (C) crystals at ~4 500 Å. With particle excitation A was free from scattering of e emitted light, and in screens of > 200 mg/cm² d greater efficiency than B and C, which had eater absolute light output but marked scattering operties. Absolute efficiencies for ZnS . Ag, A, and C were 28, 0·3, 1·0 and 0·6% respectively and e output obtained from screens ("technical yield") is in similar relative proportions. With β-ray citation A, B and C showed higher technical yields ough not absolute efficiencies) than ZnS . Ag. A is best in screens of > 300 mg/cm², and again at 600 mg/cm² for γ-ray excitation, in which case e absolute efficiencies for A, B and C were 5, 7·5 d 11% compared with 13·5% for ZnS . Ag, and e technical yields 10, 5·8 and 2·4 times that of nS . Ag. Melting reduced the light output to a w value (B and C) or zero (A). On resolidification e initial brightness was only half regained by A d B, probably on account of degradation of citation energy by a small proportion of molecules t built into the ideal crystal lattice. The origin of e luminescent transitions is discussed, especially e role of the double-bond electrons, and the low iciency to α-particle excitation is considered iefly. S. T. HENDERSON

535.376

32. Gamma-scintillations in diphenylacetylene. F. RAVILIOUS, J. O. ELLIOT AND S. H. LIEBSON. tter in *Phys. Rev.*, **77**, 851 (*March* 15, 1950).

A previous report [Abstr. 7105 (1949)] of high n. ratio for scintillations from diphenylacetylene mpared with stilbene (6 : 1 ratio) is confirmed ing flake form crystals and Ra γ-rays. A decay nstant of 8×10^{-9} sec is obtained for these crystals. G. F. J. GARLICK

535.376

33. The effect of electrolytes on the cathodoninescence of zinc oxide. S. LARACH. *J. Phys. ll. Chem.*, **54**, 467–71 (*April*, 1950).

The efficiency of luminescence of a ZnO phosphor der cathode-ray excitation can be altered by eviously treating the phosphor crystals with ctrolytes in aqueous solution, and subsequently ving. A theory of perturbation of the surface ers of the phosphor crystals is proposed to account the changes in cathodoluminescence efficiency, d an empirical expression is given which correlates iciency with the ionic charge/ionic radius ratio of e adsorbed electrolyte ions. A.

535.376

34. Decay time of stilbene scintillations as a ction of temperature. R. F. POST AND N. S. REN. Letter in *Phys. Rev.*, **78**, 80–1 (*April* 1, 50).

535.376 : 548.0

5735. Remarks on the luminescence of ionic crystals. J. FRANCK. *Ann. Phys., Lpz.* (*Folge* 6) **3**, 62–9 (1948) *In German.*

By analogy with the vibrational, non-radiative, degradation of excitation energy in complex molecules, the absence of light emission when electrons are trapped in crystals is explained. Luminescence of activated centres in crystals is explained by weak coupling of electronic states in the centre complex with vibrational states of the crystal lattice. Excitation of phosphorescence in these complexes is compared to fluorescence sensitization, and ascribed to a radiationless combination of an electron with a centre complex in the lattice. These ideas may explain the characteristics of Tl activated phosphors. G. F. J. GARLICK

535.39

5736. Calculation of the reflectivity of multi-layers of λ/4 thickness. K. ISHIGURO. *J. Phys. Soc. Japan*, **4**, 366–7 (*July–Dec.*, 1949).

By means of a simplifying mathematical transformation generalized formulae are derived for transmission and reflection coefficients produced by multi-layers of λ/4 thickness deposited on glass surfaces. The condition for zero reflectivity is derived. Expressions given include cases for either an even or an odd number of layers. The condition for enhancing reflectivity to a maximum for a given number of films is also derived for both odd and even numbers of films. A correction is made to an error in the formula for transmission occurring in a paper by W. Weinstein [Abstr. 2851 (1947)]. S. TOLANSKY

535.39

5737. Theory of propagation of plane waves through homogeneous layers. B. D. TARTAKOVSKIĬ. *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 3) 465–8 (1950) *In Russian.*

The calculation of the reflection and refractive indices on the passage of plane waves through n homogeneous plane layers of arbitrary wave resistances and thicknesses, bounded by semi-infinite media, leads to the solution of a system of $2(n+1)$ algebraic equations obtained by the substitution into the boundary conditions of the expressions for the potentials of the proceeding and receding wave in the bounding media and layers. The solution allows the reflection and propagation coefficients in the medium $n+1$ to be found. A drawback of previous methods was the impossibility of assessing the influence of all the successive layers, except the last, on the value of the coefficients. Author extends the usual method to include the missing determination, proves the correctness of the procedure by complete induction and treats a special case as example, viz. perpendicular incidence of optical waves from vacuum into a composite medium. B. F. KRAUS

535.39 : 535.41 : 535.345.6

5738. The construction of interference filters for the transmission of light of specified wavelengths. K. M. GREENLAND AND C. BILLINGTON. *Proc. Phys. Soc., Lond. B*, **63**, 359–63 (*May*, 1950).

Optical interference filters are composed of thin films deposited on a glass base by volatilization in a high vacuum. The narrowness of the transmission

bands characteristic of these filters demands a high degree of accuracy in the regulation of the thickness of the films if maximum transmission is to occur at a specified wavelength. A method of observing the optical thickness of transparent films during deposition is described and it is concluded that its accuracy is sufficient, for instance, to enable the centre of a 4th-order transmission band to be placed within 20 Å of any wavelength in the visible spectrum. A.

535.39 : 535.41 : 535.345.6

5739. Calculation of interference filters. J. ROIG AND C. DESCAMPS. *C.R. Acad. Sci., Paris,* **230,** 827–9 (*Feb.* 27, 1950) *In French.*

Calculations are made for interference filters consisting of multiple layers. Reflectivity and transmission coefficients are calculated for normal incidence by means of recurrence formulae. The calculations are given for transparent quarter-wave films and for half-wave films. The formulae establish that the selectivity depends on the number of films.

S. TOLANSKY

535.39 : 539.23 : 518.4

5740. Graphical method for the simultaneous determination of the optical constants and the thickness of thin metallic films. D. MALE. *C.R. Acad. Sci., Paris,* **230,** 1349–51 (*April* 3, 1950) *In French.*

The above values are derived from a graphical method previously mentioned [Male, *J. Phys.*, **6,** 405 (1945)] and the method is applied to Goos and Murmann's data. The double-bends obtained by these workers in the curves relating the transmissivity with thickness for Au and Ag respectively are explained without reference to Blackman's theory. A table is given. R. A. WEALE

535.39 : 539.234

5741. The structure of evaporated metal films and their optical properties. R. S. SENNETT AND G. D. SCOTT. *J. Opt. Soc. Amer.*, **40,** 203–11 (*April,* 1950).

535.4

5742. Quantitative proof of boundary waves in optics. H. MAECKER. *Ann. Phys., Lpz.* (*Folge* 6) **4** (*No.* 8) 409–31 (1949) *In German.*

The boundary waves previously known in seismology are shown to exist in optics. A divergent spherical wave from a point source in a dense medium is made to fall upon the surface between this and a lighter medium. Near the normal the wavefront is refracted, beyond the critical angle it is reflected, while in the narrow region of the critical angle a reflected plane boundary wavefront is formed. Experimental evidence establishes the existence of this wavefront and proves its origin. The intensity of the boundary wave is found as a function of wavelength and polarization of the light and the experimental values shown to agree with the theory. By the use of convergent light, the boundary wave is shown to originate in the ray displacements and phase shifts present at total internal reflection.

R. W. FISH

535.4

5743. Concerning diffraction. P. M. DUFFIEUX; G. TORALDO DI FRANCIA. *Atti. Fond.* "*Giorgio Ronchi,*" **5,** 1–8 (*Feb.*, 1950) *In French and Italian respectively.*

An exchange of letters between the two authors. Problems of the fundamental basis of diffractic theory and in particular the problems of "boundar waves" are discussed. Duffieux considers that a diffraction effects are 3-dimensional and that man outstanding difficulties might be solved by consider tion of the propagation of photons in materials atomic dimensions. Toraldo, on the other hand considers that 2-dimensional theory is legitimat and that the difficulties can be dealt with by treatmer on the lines of Maxwell's equations for wave pr pagation and the wave mechanical view of the atom R. W. FIS

535.41

5744. The spatial photographic recording of fri interference phenomena. R. N. WOLFE AND F. EISEN. *J. Opt. Soc. Amer.*, **40,** 143–6 (*March,* 1950

Interference bands as close together as 0·4 μ wer recorded with the Kodak Type 548 spectroscop plates. The penetration of these bands into th emulsion layer was detected by microscopic examina tion of a vertical section of the photographic recor The photographic record of such bands, the spacin between which depends only upon the angular tilt of Lloyd mirror and the wavelength of the radian energy being used, should prove useful as a stag micrometer. Since these photographic recor behave as diffraction gratings, the spacing betwee the band images was checked by measuring th diffraction angle, using radiant energy having a wav length shorter than the spacing. A

535.41

5745. On the interference color of thin layers o glass surface. H. KUBOTA. *J. Opt. Soc. Amer.*, **4** 146–9 (*March,* 1950).

To effect the precise examination of the interferenc colours of thin layers, they were calculated in th cases of non-reflecting layers and Newton's ring and plotted on the I.C.I. graph. The significance c several results indicated by the graphs is discussed. A

535.41

5746. On the interference color of thin layers o glass surface. H. KUBOTA. *J. Phys. Soc. Japan,* 5 10–14 (*Jan.–Feb.*, 1950).

The colour sequences in the Newton's rings pro duced by white light and in the reflections given b thin interference layers used for blooming are cal culated and plotted on an I.C.I. colour graph. Th sensitive colour shown by a thin uniaxial crysta plate between crossed nicols is studied, calculation being made on the uniform chromaticity scale Change of colour sensitivity with thickness calculated. S. TOLANSK

535.41

5747. A sensitive adjustment for interferomete plates. O. S. HEAVENS. *J. Sci. Instrum.*, **27,** 17 (*June,* 1950).

The device is of simple, robust construction and not susceptible to vibrational disturbances. The fin adjustment enables the points of support of one o the interferometer plates easily to be set to within quarter of a wavelength. A

535.417 : 531.71

Accurate thickness measurements with a Fabry Perot interferometer. *See Abstr.* 5543

535.42

'48. A system of diffraction fringes of high ntrast. A. KASTLER. *C.R. Acad. Sci., Paris*, **230**, 52–4 (*March* 13, 1950) *In French.*

This system of fringes is formed by creating a 0° phase difference between the two portions of a ane wave front on either side of a straight dividing e. The fringes are similar in spacing to those rmed by diffraction at this straight edge if one half re rendered opaque, but are now symmetrical out a dark centre and have greater contrast. xperimentally the fringes have been obtained by ing 2 adjacent half-wave plates, whose axes are at ght angles, to divide the wavefront. Further appli- tions of this double half-wave plate are briefly scussed. R. W. FISH

535.42 : 522.21

The effect of small irregularities of surfacing in tronomical reflectors. *See Abstr.* 5420

535.421

'49. The torus grating. H. HABER. *J. Opt. Soc. mer.*, **40**, 153–65 (*March*, 1950).

The torus grating is defined as a calotte of a rcular torus bearing a grating ruling on its concave de. In contrast to the spherical grating, the torus ating is capable of eliminating astigmatism, in neral, for two points in the spectrum. These two igmatic points can be adjusted to any desired wave- ngth within a wide range of the spectrum by choosing itable values for the angles of incidence and diffrac- on. In the rest of the spectrum produced by a torus ating, astigmatism is considerably smaller than that evailing in spectra of spherical gratings. Moreover, tigmatism is negligible in the proximity of the two igmatic points, giving rise to "quasi-stigmatic" nges in the torus grating spectrum. The extension these quasi-stigmatic ranges depends on the size of lerable astigmatism. If based upon an astigmatism ual to the diffraction width of the spectral images, quasi-stigmatic range can be wider than 1 000 Å. ith light sources of small size a considerable gain spectral intensity results from the lack of astig- atism. The theory of the torus grating in this aper further demonstrates that coma, aberration nd curvature of spectral lines in the torus grating ectrum are generally smaller than the same image perfections in the spectrum of the spherical grating. A.

535.421 : 535.8

'50. Specifications for optical gratings. E. INGEL- AM. *Ark. Fys.*, **2**, *Paper* 13, 105–13 (1950).

A specification prepared for the International ommission of Optics for the guidance of users and anufacturers of gratings. Standards of material, mensions and spacing are given, and standard ethods of testing proposed. Appendices give ferences to original sources, a list of manufacturers gratings with their ruling capacity, and 3 plates ustrating the recommended testing methods. R. W. FISH

535.43

'51. Macrodistribution of light scattered by spersions of spherical dielectric particles. H. H. HEISSING. *J. Opt. Soc. Amer.*, **40**, 232–43 (*April*, '50).

535.51 : 523.746 : 522.612

The use of Savart fringes in the observation of Zeeman effects in sunspots. *See Abstr.* 5422

535.55 : 532.13 : 539.501

5752. Optical methods for the study of structural change in lubricants. G. V. VINOGRADOV. *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 3) 505–8 (1950) *In Russian.*

Photographic processes for the study of the microstructure of colloidal viscosity and the disintegrating effects upon it of different tensions are described. Photographs are reproduced showing, e.g., the laminar flow of a Na lubricant round a circular obstacle placed in a plane capillary; the movement, photographed in polarized light, of lubricants at low pressures of displacement, proceeding in the form of a continuous columnar agglomeration of units of different sizes; the flow of homogenized lubricants photographed in both circularly and plane-polarized light. It is claimed that the methods of photo-elasticity and photo-viscosity described, resulting in "stills" of rheological dispersal systems, enable (1) macro-rheological processes to be controlled, (2) cases not hitherto accessible to calculation and rheological assessment to be reduced to a simplified form, (3) the kinetics and dynamics of structural change to be clearly related to systematic structure. J. CLEUGH

535.55 : 532.7

5753. New formulae for double refraction in liquids. A. M. MALEWSKI. Letter in *Research, Lond.*, **3**, 240–1 (*May*, 1950).

As double refraction occurs in isotropic liquids under the application of an electric field or the shearing action occurring in laminar flow it is assumed that the liquid molecules undergo deformation, the strain energy being stored. The increase in strain energy per molecule multiplied by the ratio of the frequencies of the incident light and the light absorbed equals the decrease of kinetic energy of the light in the liquid. From this statement an expression for Maxwell's constant is deduced and values obtained from it are quoted to be in agreement with the experimental values of Winkler and Buchheim. An expression for the Kerr constant is given and applied to benzene. Application to the Cotton–Mouton effect does not give accurate values. [See Stuart and Menz, *Z. Phys.*, **112** (*No.* 7–8) 407–19 (1939); Abstr. 1096 (1944)] H. G. JERRARD

535.56 : 539.132

5754. Theory of polarizability and optical activity. M. V. VOLKENSHTEĬN. *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 3) 447–60 (1950) *In Russian.*

A classical theory is developed in which the molecule is a sum of groups with anisotropic polarizability. The dipole moment is calculated taking account of the phase difference of the light wave in different parts of the molecule and the inductive exchange effects of the parts. Thus optical activity is expressed in terms of anisotropy of polarizability of the components and of their mutual orientations. The interacting atom groups in an optically active molecule must in general be considered anisotropic; the molecule must not be compact as van der Waals' bond-forces are assumed. J. JACOBS

535.65

5755. Calculation of subtractive color mixtures. H. R. DAVIDSON. *J. Opt. Soc. Amer.*, **40**, 230–1 (*April*, 1950).

A set of simple equations for the calculation of tristimulus values of subtractive colour mixtures in solution has been developed for the specialized case in which the ratios of transmittances of the component colorants are constant over all wavelengths in the visible spectrum. The values calculated are shown to represent the maximum values for mixtures of components with ratios of transmittance which differ from the specialized case, and it may also be demonstrated that no points of inflection may exist in the plots of tristimulus values *v.* concentration of components. In practical mixtures, departures from these theoretically derived relationships are due to interaction of the components. In use, the equations prove to be sufficiently accurate for calculation of tristimulus values of most mixtures in which the colour gamut is small. A.

535.8 + 531.7 + 536.08 + 533.5

5756. Optical, mechanical, thermal and vacuum instruments at the Physical Society's exhibition. H. BARRELL. *J. Sci. Instrum.*, **27**, 151–3 (*June*, 1950).

535.89 : 541.14

5757. Mercury 1850 Å and xenon 1470 Å resonance lamps as ultraviolet sources for photochemical studies. J. R. DACEY AND J. W. HODGINS. *Canad. J. Res. B*, **28**, 90–5 (*March*, 1950).

HEAT 536

536.2.01/.02 : 517.947.43

5758. Laws of heating and cooling of a furnace fed with constant heat flux. G. RIBAUD. *C.R. Acad. Sci., Paris*, **230**, 1011–15 (*March* 13, 1950) *In French.*

Theoretical. In accordance with Abstr. 203, 204 (1949) and considering the heat transfer through the furnace wall, formulae for the temp. of the interior of the furnace are derived. S. WEINTROUB

536.2.08

5759. A modification of the electrical method for the measurement of thermal conductivity. C. CODEGONE. *Atti Accad. Sci. Torino*, **80** (*No.* 1) 208–12 (1944–45) *In Italian.*

Theoretical. A modification suitable for high temperatures and for refractories which are electrical conductors. Only the exposed surface temperature and the electrical resistance of the cylindrical sample are required. S. WEINTROUB

536.22

5760. The heating and cooling power of liquid medium bath. I. S. SAKUI AND K. SATO. *J. Sci. Res. Inst., Tokyo* (*No.* 1223–6) 102–13 (*Jan.*, 1950).

The heating and cooling rates of thin wire when dipped in the liquid medium bath were measured by recording the change of electric resistance of wire with an electromagnetic oscillograph. The effects of falling velocity of wire, the kinds of metals and diameters of wires, the kinds of liquid mediums on the rate of temperature change were measured. A.

536.253 : 551.5

5761. Experimental studies in thermal convectio A. O. RANKINE. *Proc. Phys. Soc., Lond. B,* 225–57 (*April*); *ibid., A*, **63**, 417–43 (*May*, 1950).

33rd Guthrie Lecture. A description of war-tir research work performed by the author in connectio with the dissipation of fog over airfields. A wi tunnel was constructed in the Empress Hall, Ear Court, London, and experiments conducted in th tunnel on the distribution of heat from line burne The fuel used was butane. Systematic measureme of the temperatures (by thermo-elements) a velocities (by anemometers) of the moving air we carried out for heat emissions ranging from 0·03 0·48 therms/yd hr, and for imposed winds fro 1 to 5 ft/s at mid-height (6 ft) of the tunnel. T results are given in tabular form in the Appendi and a few cases represented graphically. An expe mental comparison was made of the convective he fluxes for luminous and non-luminous burning, a it was concluded that for petrol burnt non-luminous somewhat more than 80% of the gross heat would b available for fog dissipation. S. WEINTRO

536

5762. On the behaviors of metals during rap heating and rapid cooling. I. S. SAKUI. *J. Sci. Re Inst., Tokyo* (*No.* 1223–6) 87–101 (*Jan.*, 1950).

Transient phenomena during extremely rap heating and cooling were studied with the purpose investigating the mechanism and rate of processes b which metals change their properties during annealin The processes studied are recovery, relief of intern stress, recrystallization, grain growth, phase chang etc.

536.4

5763. On the thermal expansion of cuprous oxid R. UNO AND T. OKADA. *J. Phys. Soc. Japan*, 23–5 (*Jan.–Feb.*, 1950).

Specimens 15×5×1·5 mm are measured relativ to quartz and the apparatus calibrated by using C Two electrodes, 4 mm apart, on the specimens serv to measure the electrical conductivity. The result shown graphically, indicate 5 phases, α, β, γ, δ and separated by the temps., 250–300°c, 100°c, 0°c an — 50°c. It was observed that the expansion di not follow immediately on the temp. change (relaxa tion phenomenon). S. WEINTRO

536.4

5764. Heat stresses in discs. E. MELAN. *Öst Ingen. Arch.*, **4** (*No.* 2) 153–6 (1950) *In German.*

It is shown that no stresses occur in a thin dis submitted to a stationary temperature distributio as long as there are no sources of heat in the interio of the disc. A.

536.41 : 538.65

5765. The iron-platinum invars and their expansio anomalies. A. KUSSMANN, M. AUWÄRTER AN G. VON RITTBERG. *Ann. Phys., Lpz.* (*Folge* 6) (*No.* 3–4) 174–82 (1948) *In German.*

The results of measurements of the linear expansion of quenched and annealed Fe–Pt alloys over th range of temp. of about — 150 to 750°c are show graphically and discussed. The alloys which contai 54 to 65% by weight of Pt have expansion coefficient

uich in the quenched state vary from a small +ve alue to as low as -30×10^{-6} per °C, and in the an- aled state are approx. zero within the range — 100 300°C. The phenomena observed are strongly pendent on the heat conditions, and are attributed the high magnetostriction of the alloys. The ssible technical use of the alloys is briefly discussed.

S. WEINTROUB

536.413.2

766. Specific heat and thermal expansion of $BaTiO_3$. S. SAWADA AND G. SHIRANE. *J. Phys. Soc. Japan*, **4**, 52–6 (*Jan.–Feb.*, 1949).

These were measured between room temperature nd 250°C, and their anomalies were confirmed. The ecific heat, which was measured by Sykes's method, owed a λ-type anomaly at the Curie temperature, t the magnitude of the anomaly at the peak was nsiderably smaller, amounting to only 0·005–·015 cal/g °C. The thermal expansion was measured ith an optical dilatometer, and a contraction was served in the transition region. The thermal pansion coefficient showed a negative peak at the urie temperature. A.

536.423.4

767. Time lag in the nucleation of supercooled ater clouds by silver iodide smokes. H. REISS. *Chem. Phys.*, **18**, 529–33 (*April*, 1950).

A mechanism is proposed by means of which the me lag in phase transitions initiated by foreign odies may be calculated. Calculations are per- rmed for AgI nucleating supercooled water clouds, nd the results are compared with experimental ata. A.

536.424.1 : 536.63 : 537.226.8 : 548.7

768. The heat capacities and dielectric constants of me alkyl halides in the solid state. L. M. KUSHNER, . W. CROWE AND C. P. SMYTH. *J. Amer. Chem. Soc.*, **2**, 1091–8 (*March*, 1950).

536.46

769. Experiments on stability of Bunsen burner ames for turbulent flow. L. M. BOLLINGER AND . T. WILLIAMS. *Rep. Nat. Adv. Comm. Aero., Vash.* (*No.* 913) 6 *pp.* (1948).

Presents the results of a study of the stability of ropane-air flames on Bunsen-burner tubes. Fuel-air atio, tube diameter and Reynolds number were the rimary variables. Regions of stability are outlined n plots of fuel-air ratio as a function of Reynolds umber for flames seated on the burner lip and for ames suspended well above the burner. For fully eveloped flow, turbulent as well as laminar, the elocity gradient at the burner wall is a satisfactory ariable for correlating the fuel-air ratio required or blow-off of seated flames for fuel-air ratios of ss than 15%. For turbulent flames, wall velocity rves as a correlating variable in the same fuel-air atio range. (Bibl. 4). INDEX AERONAUTICUS

536.46

770. Basic studies on flame stabilization. G. C. VILLIAMS. *J. Aero. Sci.*, **16**, 714–22 (*Dec.*, 1949).

A report of initial studies is made to determine the echanism of anchoring flame in high-velocity air-fuel streams. The limiting gas velocities above which flames blow off the stabilizers were studied as affected by (1) approach gas stream variables (fuel-air ratios, turbulence, fuel type), and (2) stabilized variables (size, shape and addition or extraction of heat). Conclusions reached as a result of the experiments are illustrated with graphs and summarized. (Bibl. 9).

INDEX AERONAUTICUS

536.46

5771. Low-pressure flames and flame propagation. A. G. GAYDON AND H. G. WOLFHARD. *Fuel*, **29**, 15–19 (*Jan.*, 1950).

The experimental technique for running pre-mixed flames down to pressures of a few mm is described. Measurements on the limits of flame stability for hydrocarbon flames are reported, and measurements of burning velocities down to very low pressures are given. For flames with O the burning velocity is nearly independent of pressure. It is shown that the thickness of the reaction zone increases at low pressure and is always nearly equal to the distance which free H atoms from the hot burnt gases may diffuse back against the gas stream. The importance of the diffusion of H atoms in propagating flames through pre-mixed gases is pointed out and recent work by Bartholomé [Abstr. 1706–7 (1950)] suggesting a purely thermal theory of propagation for hydrocarbon/air flames is criticized. The effective ignition temps. are below 1 300°K, not above 2 000° as he suggests. A.

536.46

5772. A photoelectric investigation of the cool flame of ether. L. OUELLET, E. LEGER AND C. OUELLET. *J. Chem. Phys.*, **18**, 383–90 (*March*, 1950).

A method is described, in which the light from a cool flame under the form of a static, uniform glow is measured as a function of time by means of a multiplier photo-tube and a single-sweep c.r.o. The circuit embodies an a.c.-d.c. amplifier and a slow sweep. Cool flames of diethylether-O mixtures in a Pyrex cylinder 4·6 cm in dia. have been studied under the following range of conditions: 180–250°C, 0–150 mm and 5–95% ether. The pulsating glow, which lasts about 1 sec, shows two and sometimes more maxima. The generally accepted lower pressure limits appear as regions of feeble but smoothly decreasing intensities. Under the conditions of the experiments, the temperature coefficient is negligible. Both intensity and integral emission increase regularly with the concentrations of the reactants and are maximum at 50% ether by volume, the variations being roughly symmetrical with respect to the partial pressures of either component. Variations of pressure and composition cause regular but considerable changes in the shapes of the oscillograms. Light and pressure pulses follow each other closely, suggesting that the latter are of mainly thermal origin and that the light intensities reflect the instantaneous reaction rates. The glow lasts longer in the wider vessels. In the presence of the reaction products, it either fails to appear or emits the normal amount of light. A preliminary analysis of the quantitative data is given and possible interpretations, in terms of oxidation mechanisms, are discussed. A.

536.46

5773. Reactions between nitrogen dioxide and formaldehyde. III. The determination of flame speeds. F. H. POLLARD AND R. M. H. WYATT. *Trans. Faraday Soc.*, **46**, 281–9 (*April*, 1950).

The spatial velocities of flames moving in mixtures of NO_2 and HCHO at initial pressures of 4–8 cm Hg in a spherical vessel, have been measured using Schlieren photography. The velocity is independent of the initial pressure of the mixture, and reaches a maximum for a mixture containing 43·2% HCHO, which is slightly higher than the stoichiometric mixture of 41·5%. The relative importance of H, O and OH in the flame processes is discussed and variations in the delay period are considered in relation to current theories of spark ignition. A.

536.46

5774. Measurement of normal burning velocities of propane-air flames from shadow photographs. J. W. ANDERSEN AND R. S. FEIN. *J. Chem. Phys.*, **18**, 441–3 (*April*, 1950).

The limitation placed upon the stroboscopically illuminated particle method of measuring the normal burning velocity by the heat capacity of the particles is discussed. A supplementary method of measuring the normal burning velocity using a modified Gouy procedure is presented. The line between the dark and light spaces on shadow photographs, taken at different distances from the flame to the film, is used in this method to define the flame area. This area is then extrapolated to the diametral plane of the flame. This procedure gives results that are consistent with the particle method of determining the normal burning velocity and its use is justified empirically. Burning velocities of propane-air flames are given. A.

536.46

5775. Stability of burner flames with propane-hydrogen mixtures. S. H. REITER AND C. C. WRIGHT. *Industr. Engng Chem.*, **42**, 691–4 (*April*, 1950).

536.46 : 535.33

5776. Spectroscopic studies of low-pressure flames. III. Effective rotational temperatures and excitation mechanism for C_2 bands. A. G. GAYDON AND H. G. WOLFHARD. *Proc. Roy. Soc. A*, **201**, 561–9 (*May* 23, 1950).

Intensity measurements on the Swan bands of C_2 give effective rotational temperatures for a number of flames. For oxygen/acetylene at 1 atm. the value is 4 950°K, falling to 3 800°K at 2 mm. For acetylene/air it is 3 400°K at 1 atm., falling a little at low pressure. In discussing the excitation process, reasons are given against its being a true chemiluminescence. It is believed that the C_2 radicals are formed with high rotational energy and are electronically excited by collision with energy-rich molecules present in the flame and responsible for the high excitation temperatures previously recorded. These energy-rich molecules probably possess excess vibrational energy. A.

536.46 : 535.33 : 535.379

5777. Spectroscopic studies of low-pressure flames. IV. Measurements of light yield for C_2 bands. A. G. GAYDON AND H. G. WOLFHARD. *Proc. Roy. Soc. A*, **201**, 570–86 (*May* 23, 1950).

The light yield for the Swan bands is measured for a number of hydrocarbons. For $C_2H_2 + 2\frac{1}{2}O_2$ flames 3×10^{-5} photons are emitted for each O_2 consumed at 1 atm. pressure, rising to $13 \cdot 5 \times 10^{-5}$ at 3·5 mm pressure. For propane the effect of pressure is more marked. The effect of mixture strength and of diluents is studied. For partial replacement of hydrocarbon by H_2 or CO (the mixture being held stoichiometric) the yield falls with surprising rapidity being proportional to a high power of the hydrocarbon concentration (square to sixth power). Preliminary results for CH are similar. The C_2 emission does not appear to be due to true chemiluminescence, but there is abnormally high excitation by some active species in the flame, and the concentration of C_2 exceeds the values found by Brewer, Gilles and Jenkins for equilibrium with solid carbon at the flame temperature. Polymerization and formation of unsaturated compounds appears to be important. The relation between C_2 emission and the formation of solid C is discussed; polymerization of C_2 cannot account quantitatively for the formation of solid particles. A.

536.462 : 536.521 : 535.341

5778. Determination of the absorption coefficients of soot particles from various flames. F. RÖSSLER AND H. BEHRENS. *Optik*, **6**, 145–51* (*March*, 1950) *In German.*

In the measurement of flame-temperature by optical methods it is necessary to know how the absorption coeff. varies with wavelength. It is known from earlier work that the absorption-wavelength relation is the same for soot-particles deposited on glass as when they are in the flame, so in this investigation samples of soot-particles were taken by holding cool microscope slides in the flame. Light from a monochromator was passed through the soot-covered slide and the emergent intensity was measured by a photocell with electrometer amplifier; to collect scattered light the photocell was placed close to the sample slide. Measurements of absorption coeff. were made over a region extending from the near u.v. to the near i.r. (3 000 Å to 10 000 Å). The absorption coeff. is proportional to λ^{-n} (where λ is the wavelength). It is found, for a variety of flames of hydrocarbons burning in air and in NO, that n lies between 0·65 and 1·43. Although of course the absorption coeff. itself depends on the thickness of the soot-layer deposited on the sample slide, the value of n does not. A. SCHOFIELD

536.48

5779. Lambda-temperatures of solutions of He^3 in He^4. O. G. ENGEL AND O. K. RICE. *Phys. Rev.*, **78**, 55–7 (*April* 1, 1950).

An expression for the effect of He^3 on the λ-point of He^4 is developed from thermodynamic principles. Use is made of the idea that normal He^4 and superfluid He^4 are in equilibrium with each other and that the λ-temperature is the temperature at which superfluid first appears. This expression contains the difference in enthalpy of normal fluid and superfluid. The λ-points of mixtures containing large amounts of He^3 are discussed on the basis of various assumptions

garding this difference in enthalpy as a function of nperature. A.

536.48 : 531.19

80. Statistical mechanics of liquid mixtures of ^{3}e and He^4. J. DE BOER AND C. J. GORTER. *Physica*, , 225–38 (*March*, 1950).

In order to account for their vapour pressure easurements on dilute mixtures of He^3 and He^4 iconis, Beenakker, Aldrich and Nier have suggested at He^3 only dissolves in the normal part of He^4 and ot in its superfluid part. On the basis of this sug- stion the statistical mechanics of these mixtures has en developed. Two different assumptions about the action of the He^4 which is in the normal state have en considered. According to assumption A this action adjusts itself in the mixture in such a way hat Gibbs's function is a minimum, whereas according o assumption B this fraction is independent of the He^3 concentration. Case A leads to a λ-point which ecreases with rising He^3 concentration. Case B, n the other hand, leads to a transition of the first rder and to a decomposition of the mixtures into two o-existing phases below the λ-temperature of pure He^4. Accepting provisionally the expression for Gibbs's function of He^4 which corresponds to Tisza's pecial version of the 2 fluid model, a few computa- ions have been made about expected transition lines nd vapour pressures. A comparison is made with tout's approach to the same problems. A.

536.48 : 532.13

5781. Viscosity of mixtures of He^3 and He^4. D. TER HAAR AND K. WERGELAND. Letter in *Phys. Rev.*, **75**, 886–7 (*March* 1, 1949).

536.48 : 534.2

5782. The theory of the propagation of first and econd sound in helium II. Energy theorems and rreversible processes. R. B. DINGLE. *Proc. Phys. Soc., Lond. A*, **63**, 638–52 (*June*, 1950).

The conditions determining whether sound waves n He II are propagated isothermally or adiabatically re discussed. An expression is found for the energy lux from a closed region, and the impedance concept s applied to waves of second sound. In the second art of the paper the effects of irreversible processes n the propagation of waves of first and second sound re studied. The irreversible processes discussed re those due to viscosity and thermal conduction, oth in an extended fluid and in a narrow tube. A.

536.48 : 536.75

5783. Measurements of the influence on the fountain effect of He^3 dissolved in He^4. K. W. TACONIS, J. J. M. BEENAKKER AND Z. DOKOUPIL. Letter in *Phys. Rev.*, **78**, 171 (*April* 15, 1950).

536.48 : 536.75

5784. The partial molal entropy of superfluid in pure He^4 below the λ-point. O. K. RICE. Letter in *Phys. Rev.*, **78**, 182–3 (*April* 15, 1950).

536.48 : 538.22

The magnetic properties of liquid He^3. *See Abstr.* 5950

536.483 : 533.6.011

5785. A simply constructed vortex tube for producing hot and cold air streams. M. P. BLABER. *J. Sci. Instrum.*, **27**, 168–9 (*June*, 1950).

A simplified form of Hilsch's device [Abstr. 1512 (1947)] is described, which will produce a stream of hot air and a stream of cold air (maximum temperature 88°C, minimum temperature −20°C) from a source of compressed air at room temperature. A.

536.53

5786. A series parallel linear thermopile with interchangeable receiving units. R. A. CRANE AND F. E. BLACET. Letter in *Rev. Sci. Instrum.*, **21**, 259 (*March*, 1950).

536.531 : 541.126

5787. Some extensions in the use of resistance thermometry in the study of gaseous explosions. A. S. LEAH, C. ROUNTHWAITE AND D. BRADLEY. *Phil. Mag.*, **41**, 468–77 (*May*, 1950).

A modified technique for recording resistance wire temperatures is described. By using plain and quartz-coated wires as the resistance elements in explosions a possible method of investigating the course of the reactions occurring within the flame reaction zone is suggested. The corrections to be applied to estimate the true flame gas temperature from the quartz-coated wire records are evaluated. A method of determining the rate of catalytic heating on the plain wires is outlined and the results from a typical explosion of a 90% $CO + 10\%$ O_2 mixture at 0·4 atmos. initial pressure are shown. The thickness of the reaction zone in the early stages of the explosion is estimated to be 4 cm. A.

536.55 : 537.523.5

On the temperature of the anode crater in high current pure carbon arcs. *See Abstr.* 5859

536.62

5788. A calorimeter for the measurement of small amounts of heat liberated slowly. W. HIRST AND M. KERRIDGE. *J. Sci. Instrum.*, **27**, 161–3 (*June*, 1950).

A calorimeter is described for the measurement of quantities of heat of the order 1 to 10 cal. Its special feature is that the heat leakage remains approximately constant, and determinable to $\pm$ 0·1 cal/hr, over periods of several hours; it therefore allows slow reactions to be followed. Experimental curves are given showing how, when it is known that the heat leakage is sensibly constant, the form of the experimental curve may immediately suggest the nature of an interaction. A.

536.62 : 539.16.08

5789. A microcalorimeter suitable for study of easily absorbed nuclear radiations. C. V. CANNON AND G. H. JENKS. *Rev. Sci. Instrum.*, **21**, 236–40 (*March*, 1950).

A microcalorimeter suitable for measuring the energy of easily absorbed nuclear radiations is described. The calorimeter is an isothermal type operating at the temperature of liquid N and using the rate of vaporization of N under constant pressure as a measure of the heat input. The calorimeter is fairly simple to construct and to operate and has a short equilibration period. Heat inputs to the calorimeter as low as 7×10^{-6} cal/s can be measured with an accuracy of 1%. A.

536.633.3

5790. The ratio of the specific heats of gases, C_p/C_v, by a method of self-sustained oscillations. W. F. KOEHLER. *J. Chem. Phys.*, **18**, 465–72 (*April*, 1950).

536.658.2

5791. Some heats of wetting of unit surfaces. F. L. HOWARD AND J. L. CULBERTSON. *J. Amer. Chem. Soc.*, **72**, 1185–7 (*March*, 1950).

A calorimeter suitable for measurement of small quantities of heat has been designed. Heats of wetting at 25°c have been measured for the systems involving H_2O, CCl_4 or *n*-heptane as the wetting liquid and sphalerite, galena, fluorite or quartz as the wetted solid, also for the systems sylvite–carbon tetrachloride and sylvite–*n*-heptane. These heats of wetting have been reduced to a unit surface basis by means of B.E.T. adsorption isotherm measurements of the specific surface areas of the solids. The relative and absolute magnitudes of these heats of wetting show evidence of chemical reaction rather than mere dipole interaction at some wetted surfaces. A.

536.66

5792. A survey of heats of mixing of some organic compounds with aluminium chloride. M. H. DILKE, D. D. ELEY AND M. G. SHEPPARD. *Trans. Faraday Soc.*, **46**, 261–70 (*April*, 1950).

THERMODYNAMICS 536.7/.8

536.7

5793. Reflections on Onsager's principle. J. E. VERSCHAFFELT. *Bull. Acad. Roy. Belg. Cl. Sci.*, **35** (*No.* 12) 976–94 (1949) *In French.*

The relationship between the author's theory of superposition and Onsager's principle is discussed. Work by Meixner, de Groot and Casimir [Abstr. 2284 (1945), 610, 1537 (1948), 2482 (1946)] is reviewed. The paper is wholly mathematical. F. E. HOARE

536.7

5794. Thermodynamic properties of sulfur. J. R. WEST. *Industr. Engng Chem.*, **42**, 713–18 (*April*, 1950).

Data on the critical properties, the vapour pressure and the molecular species present in S vapour were compiled by calculation. Enthalpy and entropy computations were made for the saturated liquid, for the vaporization process, for the saturated vapour and for the superheated vapour with allowances for dissociation. Similar calculations were made on the volume. The results are shown in tabular and graphical form. A.

536.71

5795. Thermodynamics of phase change. R. KIKUCHI. *J. Phys. Soc. Japan*, **3**, 268–9 (*July–Aug.*, 1948).

Phase changes of higher order are discussed in the light of the views advanced by Lype, Bridgman and Oldenburger [Abstr. 2587 (1946), 618, 867 (1947)].

F. E. HOARE

536.75 : 536.48

The partial molal entropy of superfluid in pure He^4 below the λ-point. *See Abstr.* 5784

536.75 : 539.13 : 541.183

5796. The entropy of adsorbed molecules. G. L. KINGTON, R. A. BEEBE, M. H. POLLEY AND W. R. SMITH. *J. Amer. Chem. Soc.*, **72**, 1775–81 (*April* 1950).

The differential heat of adsorption of N and O on TiO_2 has been determined calorimetrically at 78·5°K. The TiO_2 used in both cases was a sample of anatase with a B.E.T. surface area of 13·9 m^2/g. The magnitude of the heat in both cases indicates that the adsorption is van der Waals in nature. The initial increments of N showed a heat of adsorption approximately 1 kcal per mole higher than the initial O values. The results show that the partial molal entropy of the adsorbed gas is less than the partial molal entropy of the bulk 3-dimensional liquid or solid phases, at coverages less than a monolayer (as defined by the B.E.T. v_m), for all the systems investigated. At coverages greater than a monolayer the partial molal entropy approaches the entropy of the 3-dimensional liquid or solid. The entropy requirements of the B.E.T. theory are shown to be incompatible with experimental evidence at coverages less than a monolayer. A.

536.7533

5797. Evaporation equilibrium of multi-component mixtures. VI. Ternary systems with mixing gaps. R. HAASE. *Z. Naturforsch.*, **5a**, 109–24 (*Feb.*, 1950) *In German.*

The conditions necessary for the stability of 3-component systems are examined by using the geometric surface of free enthalpy. From this follow the ideas of an equilibrium curve for two liquid layers (mixing- or solubility-curve) and the critical mixing point. Equations for this point at a given pressure and temperature are derived after Gibbs. Further laws governing the relative positions of the liquid points and the vapour point are developed along the lines of Schreinermaker. Heterogeneous regions are considered and the importance of the distillation is explained. The boiling surface, rectification and other relevant points are discussed. E. H. DOCK

ELECTRICITY 537

537.08 : 621.317.7

5798. Electronic instruments at the Physical Society's exhibition. A. J. MADDOCK. *J. Sci. Instrum.*, **27**, 147–8 (*June*, 1950).

537.08 : 621.317.7

5799. Non-electronic electrical instruments shown at the Physical Society's exhibition. A. FELTON. *J. Sci. Instrum.*, **27**, 149–50 (*June*, 1950).

THEORY . ELECTRONS 537.1

537.11 : 538.3 : 621.3.01

5800. Some unpublished notes of Oliver Heaviside. H. J. JOSEPHS. *Instn Elect. Engrs, Paper No.* 977 (1950) 35 *pp.*

Presents some of Heaviside's unpublished theorems which are likely to be of interest. Heaviside's un-

blished notes show clearly that his views on the ture of the interaction of matter and energy anged rapidly after 1900. Following his deduction the relationship between mass and energy from axwell's pressure-of-radiation formula, Heaviside pears to have rejected the Faraday–Maxwell inter- etation of electrical phenomena as a series of esses in a continuous medium. He extended his nception of "energy-tubes" (based originally upon flux-of-energy analysis) to include their condensa- n into electronic particles, and then developed a w algebra of operational quaternions for use in his pological studies of the invariances associated with e interlocking of electronic fields. Heaviside's new tlook was well reflected in his unpublished work the particle-like structure of electromagnetic pulses d his correlation of electromagnetism with mass operties and gravitation. A.

537.133 : 539.165

01. Interaction of beta rays [from RaE] with tter. S. KOJIMA AND S. HASHIMOTO. *J. Phys. Soc. pan*, **5**, 20–2 (*Jan.–Feb.*, 1950).

An attempt was made to measure pair creation sulting from the absorption of RaE β-particles in , Sn and Cu, by observing coincidences between 0·51 MeV annihilation quanta arising from the sorption of the positrons which are supposed to formed. The method used by Feather and Dun- rth was employed in these experiments, the RaE rce being covered by sheets of the appropriate terial (thick enough to absorb the β-particles) and ced between two coincidence counters. 0·1 mm wall counters of known efficiency were employed. e cross-sections for pair creation estimated in this y ($\sim 10^{-23}$ cm^2) were $\gg$ values predicted by theory 10^{-27} cm^2). It is suggested that the observed incidences might be due to the double Bremsstrah- ng process rather than pair creation.

L. R. SHEPHERD

ECTROSTATICS . DIELECTRICS 537.2

537.221 : 551.594.21 : 543.545

02. Electrical phenomena occurring during the ezing of dilute aqueous solutions and their possible ationship to thunderstorm electricity. E. J. WORK- N AND S. E. REYNOLDS. *Phys. Rev.*, **78**, 254–9 *ay* 1, 1950).

The discovery of an electrical effect accompanying orderly freezing of dilute aqueous solutions is orted. Potential differences as great as 230 V are asured across the water-ice interface during the ezing process. At a freezing rate of about 1 cm^3 min, a current of 1 μA is measured. The racter of the effect is a function of the nature and ncentration of the solute. The dependence of the ct on the structure of the ions of the solute and molecular structure of water is shown. Possible lication of this effect to chemical detection and the formation of thunderstorm electricity is cussed. A.

537.226

5803. Tentative explanation of the hysteresis loops of Rochelle salt. T. OGUCHI, Y. TAKAGI AND G. SHIRANE. *J. Phys. Soc. Japan*, **4** (*No.* 2) 112–17 (*March–April*, 1949).

A quantitative method, based on the theories of Mueller and Eyring, is described for calculating hysteresis loops at any temperature as a function of the external field variables such as frequency, max. field strength and waveform. H. J. H. STARKS

537.226

5804. Anomalous dielectric behaviour of Rochelle salt. I–II. H. TAKAHASI AND S. HARA. *J. Phys. Soc. Japan*, **4**, 257–64 (*July–Dec.*, 1949).

The polarization/field strength curve obtained for Rochelle salt when the field strength is varied in steps, is in the form of a hysteresis loop, the width of the loop decreasing—but not becoming zero—when the rate at which the field is varied is increased. Dielectric after-effect is larger in weak fields. The polarization does not vanish at the Curie point (23°C) but persists up to about 28°C. On cooling, a spontaneous polarization appears at about 23°C, and this polarization cannot be removed by external a.c. or d.c. fields or by further heating and cooling.

E. RUSHTON

537.226

5805. Corrigendum: Time dependence of electronic processes in dielectrics. H. FRÖHLICH AND J. O'DWYER. *Proc. Phys. Soc., Lond. A*, **63**, 299 (*March*, 1950).

Two equations corrected. [See Abstr. 3139 (1950)].

537.226 : 541.132

5806. Special case of exchange action between dipoles and ions in an electrolyte solution and its relationship to the dielectric constant of the solvent. P. MORTIER. *Mem. Acad. Roy. Belge Cl. Sci.*, **21** (*No.* 9) 30 *pp.* (1949) *In Dutch.*

The Kraus–Fuoss relationship (1933) between λ (electrical conductivity) and ε (dielectric constant) is used to study a special case of the formation of triple ions in electrolyte solutions of relatively low ε, with particular reference to the formation of aggregates between the ions of the electrolyte and molecules of high dipole moment. Curves relating log λ and log stoichiometric c (concentration) for solutions of n-tetrabutylammonium picrate and thiocyanate in 2 mixtures of C_2H_5OH and C_6H_6 of ε 4·0 and 5·3 respectively, alone and in presence of n-trimethyl glycine, show well defined λ minima. J. GRANT

537.226.08

5807. An extension of the Slätis theory of the Drude–Coolidge method of measuring the dielectric constant and the coefficient of absorption. G. POTAPENKO AND D. WHEELER, JR. *Ark. Fys.*, **2**, *Paper* 9, 69–79 (1950).

537.226.08 : 621.315.61 : 621.317.336.029.6

5808. The determination of the dielectric and magnetic properties of inhomogeneous dielectrics, especially biological bodies, in the decimetre wavelength region. I. Theoretical treatment of the resonance method for determining complex resistances and materials at decimetre wavelengths. H. SCHWAN. *Ann. Phys., Lpz.*, **5** (*No.* 6–8) 253–67 (1950) *In German.*

The equations are derived for the determination of

a complex resistance at one end of a Lecher wire system in 3 cases: (1) transmitter and receiver attached to a movable short circuit, (2) load—fixed receiver—fixed transmitter—movable short-circuit in this order along the wires, (3) load—fixed transmitter—receiver attached to a movable short-circuit. Equations using measurements of max. and min. signal and using half-widths of the resonance curves are given and the advantages of the arrangements discussed. D. H. WHIFFEN

537.226.08 : 621.315.61 : 621.317.336.029.6

5809. The determination of the dielectric and magnetic properties of inhomogeneous dielectrics, especially biological bodies, in the decimetre wavelength region. II. The influence of supports at the end of the Lecher conductors. H. SCHWAN. *Ann. Phys., Lpz.*, **5** (*No.* 6–8) 268–86 (1950) *In German.*

Detailed theory of the blank correction for pure-capacitive end support or sample holder.

D. H. WHIFFEN

537.226.08 : 621.315.61 : 621.317.335.2 : 621.317.411

5810. The determination of the dielectric and magnetic properties of inhomogeneous dielectrics, especially biological bodies, in the decimetre wavelength region. III. Method of evaluation for the determination of the electric and magnetic constants of substances in the decimetre wavelength region. H. SCHWAN. *Ann. Phys., Lpz.*, **5** (*No.* 6–8) 287–311 (1950) *In German.*

The equations for determining the complex permittivity and magnetic permeability from Lecher wire systems are derived in the forms most suitable for calculation either using complex tangent tables or otherwise. Simpler approximate formulae for use with non-magnetic, with thin, with highly conducting and with non-conducting samples are also given.

D. H. WHIFFEN

537.226.1

5811. The inner field theory and method of investigation of the dielectric relaxation in polar liquids. E. FISCHER. *Ann. Phys., Lpz.*, **6**, 117–28 (1949) *In German.*

Theoretical. The inner field, induced by an applied electrical field, in a polar liquid is considered both on the basis of the Onsager Kirkwood theory and also the Debye formula. For very dilute solutions evaluation of the relaxation time on both theories yields the same result. It is suggested that the comparison of empirical values for concentrated solutions and pure liquids might lead to useful information on the effect of the dipoles on the inner field. The theory for the experimental determination of relaxation times at high frequencies is given.

T. C. TOYE

537.226.2

5812. The dielectric properties of binary systems of ketones and hydrocarbons. R. J. MEAKINS. *Aust. J. Sci. Res. A*, **53**, 405–22 (*Sept.*, 1949).

To obtain experimental results more closely related to the theory, electrical measurements were made with symmetrical long-chain ketones in pure crystalline hydrocarbon solvents. The variation of dielectric constant and loss angle with frequency for these systems is found to be approximately in agreement with the Debye theory of dielectric absorption. F ketones of chain-length shorter than that of t hydrocarbon solvent the relationship between relax tion time and chain-length is of the type expect from Fröhlich's theory, but displaced towards low frequencies. The results show that, in applying t theoretical relationship to systems of long-cha polar and non-polar compounds, it would be necessa to determine new constants for each different type polar compound and for each different solvent. T results of electrical measurements of ketone-hydr carbon systems with ketones of varying chain-leng (both less and greater than that of the solvent) are accordance with conclusions from previous X-r studies of long-chain hydrocarbons.

537.226

5813. Dielectric constants of commercial cashe shell oils. S. KRISHNAMURTHY AND B. R. Y. IYENGA *Indian J. Phys.*, **24**, 23–34 (*Jan.*, 1950).

537.226

5814. The effect of hydrostatic pressure on t Curie point of barium titanate single crystals. W. MERZ. *Phys. Rev.*, **78**, 52–4 (*April* 1, 1950).

With increasing pressure a linear shift of the Cur point towards lower temperature is observed with slope of $-5{\cdot}8\times10^{-3}$ degree/atmos. This informatic allows one to calculate the change of the specific he and of the compressibility at the Curie point accordi to Ehrenfest's relation. Thus it is possible to rela the pressure effect to the change of the latti constant. The decrease of the Curie temperatu with shrinking lattice constant is nearly the same that observed when Sr ions are substituted for Ba i the titanate crystal. In addition, measurements ha been made on the influence of pressure on the fir order transition point near 0°C.

537.226.2 : 621.3.011.5 : 621.315.61

5815. Dielectric properties of lead zirconate an barium-lead zirconate. S. ROBERTS. *J. Amer. Cera Soc.*, **33**, 63–6 (*Feb.* 1, 1950).

Methods are described for preparing Pb zirconat and mixtures of Pb and Ba zirconate in ceram form. These compositions are shown to constitute new class of ferroelectric materials having permi tivities as high as 11 000. Permittivities are measure at 1 Mc/s in a temp. range 25–350°c. Non-linea dielectric properties and piezoelectric effects a shown. METROPOLITAN-VICKER

537.228

5816. On the noise of Rochelle salt. S. KOJIM AND K. KATO. *J. Phys. Soc. Japan*, **4**, 362–3 (*July Dec.*, 1949).

Measurements on Rochelle salt crystals show th there exist two kinds of noise pulses: larger pulse observed by Schönfeld [*Ann. Phys., Lpz.*, **19**, 7 (1934) and **22**, 53 (1935)] and attributed to surfac discharges, and smaller pulses analogous to th Barkhausen effect in ferromagnetism. E. RUSHTO

537.228

5817. On the electrostrictive effect of bariu titanate. Y. TAKAGI AND E. SAWAGUCHI. *J. Phy Soc. Japan*, **4**, 363–5 (*July–Dec.*, 1949).

The transverse electrostrictive effect in a specim of $BaTiO_3$ is measured as the field strength is varie

hysteresis effect is observed at first, but after veral cycles the strain v. field strength curve becomes producible, and in addition shows a saturation ect at higher field strengths. Measurements of the rmittivity on the same specimen show a decrease permittivity with increasing biasing field strength.

E. RUSHTON

537.228.1 : 548 : 621.617.335

18. Measurement of the equivalent electrical cuit of a piezoelectric crystal. A. C. LYNCH. *oc. Phys. Soc., Lond. B*, **63**, 323–31 (*May*, 1950).

A new method for measuring the reactances in the cuit requires measurements of equivalent capaci- nce at several frequencies around that of resonance, eferably differing from the resonance frequency by om ½ to 5%; the accuracy is unaffected by capaci- nce in parallel with that of the specimen. The easurements can be made with a suitably screened bstitution Schering bridge; it should be suitable for equencies between about 50 and 600 kc/s, and the ly unusual component needed for it is a variable ndenser which can be read to 0·001 pF. If there e no unwanted modes of vibration, the equivalent cuit can be measured to within 0·1%. The piezo- ctric coefficient d is sometimes calculable from the uivalent circuit and the dimensions of the crystal, t there are difficulties which limit the accuracy of d about ½%. Results obtained include, for example, for quartz at 20°C $= 6{\cdot}9_5 \times 10^{-8}$ cm/e.s.u. of otential.

A.

537.228.4 : 535.515 : 532.74

19. The effect of rotating fields on the configura- ns of molecules in gases and liquids (rotational uble-refraction). A. LÖSCHE. *Ann. Phys., Lpz.*, (*No.* 6–8) 381–400 (1950) *In German.*

If molecules in the gaseous or liquid states are rced to rotate about parallel axes, an additional ientation takes place when the momentum-ellipsoid not symmetrical. This ordering results in bi- fringence. The theory of this effect is developed to e the variation of the Kerr double-refraction with ole moment, electric field strength and rotation quency. The effect for gases is too small for esent measurement, but the results for a number liquids such as nitro-benzene agree with prediction. e application of the method to the study of sociation in liquids is discussed.

R. F. BARROW

ECTRIC CONDUCTION . CURRENTS 537.3

537.31 : 537.56 : 621.317.311

20. A simple combination micromicroammeter d X-ray ionization chamber. R. S. ANDERSON. *ner. J. Phys.*, **18**, 119–24 (*March*, 1950).

A feedback amplifier using the circuit of Roberts *ev. Sci. Instrum.*, **10**, 181 (1939)] and enclosed in a box for laboratory teaching serves for X-ray as ll as small current measurements. It incorporates ionization chamber of 1·7 litres volume and gisters down to 2×10^{-5} r/sec.

F. T. FARMER

537.311.31

5821. The electrical conductivity of thin wires. R. B. DINGLE. *Proc. Roy. Soc. A*, **201**, 546–60 (*May* 23, 1950).

Simple approximate methods are developed for evaluating the electrical conductivity of films and wires of a size comparable with the mean free path of the conduction electrons. A rigorous theory is given of the electrical conductivity of a thin wire, on the assumptions that the Fermi velocity surface is spherical and that the collisions of the electrons at surface of the wire are inelastic This theory is generalized to cover the case where the scattering is no longer inelastic. Andrew's recent experimental results for a thin Hg wire are fitted to the theoretical curves obtained, and the mean free path evaluated.

A.

537.311.32

5822. Electric resistivity of polycrystalline graphite and carbons. S. MROZOWSKI. Letter in *Phys. Rev.*, **77**, 838 (*March* 15, 1950).

537.311.33

5823. The Fermi level in electronic semi-conductors. H. MÜSER. *Z. Naturforsch.*, **5a**, 18–25 (*Jan.*, 1950) *In German*

The position of the Fermi level relative to the top of the full band is calculated for semi-conductors of the types envisaged by Wilson (discrete impurity levels) and Gisolf (impurity levels distributed over a small energy range). It is shown that this position has a critical influence on the observed semi-conductor properties. Its dependence on temperature and on the concentration of impurity centres is examined. PbS and Cu_2O are considered in some detail. Theoretical and experimental results are found to be in good agreement.

H. K. HENISCH

537.311.33

5824. Energy band structures in semiconductors. W. SHOCKLEY. Letter in *Phys. Rev.*, **78**, 173–4 (*April* 15, 1950).

A method is proposed for determining the shapes of energy surfaces in Brillouin zones by proper comparison with experiment. The method is similar to that of Sommerfeld and Bethe for tight binding, but the more general case is illustrated by considering the wave functions near the bottom of an energy band which has its lowest energy at the centre of the Brillouin zone.

C. A. HOGARTH

537.311.33

5825. Theory of the recombination of electrons in semi-conductors. S. I. PEKAR. *J. Exp. Theor. Phys., USSR*, **20**, 267–70 (*March*, 1950) *In Russian.*

The theory of recombination of the conductivity electrons in semi-conductors on charged and neutral centres is considered. The case when the probability of localization of an electron approaching a centre is sufficiently great for the rate of recombination to be limited and determined only by the diffusion rate of the electrons to the centres of recombination, is investigated quantitatively. The recombination coefficient, average displacement of the electron in an external field and electric conductivity set up by irradiation of the crystal with ordinary light, X-rays, —ve rays or corpuscular rays are calculated. These cases represent special cases of the general case of a

disturbed thermal equilibrium of the semi-conductor, of which not even a satisfactory qualitative theory has been given so far. The treatment is based on the author's polaron theory. B. F. KRAUS

537.311.33 : 535.37

5826. Conduction electrons in non-metallic solids. H. FRÖHLICH. *Research, Lond.*, **3**, 202–7 (*May*, 1950).

Problems concerning the motion of electrons in polar and non-polar crystals arise frequently in connection with semi-conductor theory, dielectric breakdown and other branches of the theory of solids. It is shown that slow electrons in ionic crystals can be treated as point charges, subject to minor restrictions. The problem of self-trapping is examined in some detail and it is concluded that such a phenomenon cannot take place. The relation between the mean free path and temperature is particularly important. This relation, which depends on the energy of the electrons as well as on the temperature range, is different in polar and non-polar crystals. Electrons which are brought into a conduction band by an ionizing radiation eventually return to the ground state. In phosphors this is accompanied by the emission of light. In other substances, the direct transfer of the excess energy to the lattice as vibrational quanta is an improbable process. More probably the energy is first shared with other excited electrons. The concept of electron temperature is thus introduced. This temperature can be increased by the application of high electric fields. H. K. HENISCH

537.311.33 : 535.6 : 548.0

5827. Recombination of the conductivity electrons on the colour centres in crystals. S. I. PEKAR AND YU. E. PERLIN. *J. Exp. Theor. Phys., USSR*, **20**, 271–3 (*March*, 1950) *In Russian.*

See Abstr. 5825 (1950). An application of Pekar's theory of recombination to coloured alkali-halide crystals. The displacement of the photo-electron is calculated, i.e. the mean path covered by the electron in the direction of the electric field up to the instant of recombination. The displacement calculated is compared with experimental values. B. F. KRAUS

537.311.33 : 535.6 : 548.0

5828. Polarizability of the colour centre. YU. E. PERLIN. *J. Exp. Theor. Phys., USSR*, **20**, 274–8 (*March*, 1950) *In Russian.*

The polarizability of the colour (*F*-) centre in rapidly and slowly varying electric fields is calculated. The Pekar model of the *F*-centre serves as a basis for the calculation. If in a node of the crystal lattice a negative ion is missing, a conductivity electron is acted upon by the field of this defect in addition to the effect of the periodic field of the crystal, which leads to the possibility of a localization on a level below the zone of conductivity. The localized electron polarizes the crystal by forming an additional polarization trough. The form of the latter depends on the wave function, so that the condition is self-consistent. This self-consistent state, called *F*-centre, was investigated by Pekar [*J. Exp. Theor. Phys., USSR*, **17**, 868 (1947) and Abstr. 5827 (1950)]. B. F. KRAUS

537.311.33 : 537.32

5829. The theory of [the] thermoelectromotive force in semiconductors. J. YAMASHITA. *J. Phys. Soc. Japan*, **4**, 310–15 (*July–Dec.*, 1949).

An attempt to obtain improved formulae for the temperature dependence of the thermoelectric power of semi-conductors. The Boltzmann equation state is quoted in a general form and solved for the free electron case. The expression for the thermoelectric power differs from the usual one and is satisfactory agreement with experiments on Zn and Cu_2O. An expression derived on the assumption that 2 types of impurity centres are present is capable of explaining turning points and approximately horizontal portions of the characteristics. P. T. LANDSBERG

537.311.33 : 539.1

5830. Interaction between electrons and ions in semi-conductors. I. R. KUBO. *J. Phys. Soc. Japan*, **3**, 254–9 (*July–Aug.*, 1948).

The problem of an electron trapped by a positive lattice defect is considered, using the approximation in which the undisturbed lattice is treated as a continuous dielectric of known static and optical dielectric constants. An analogous problem has been treated by Tibbs [Abstr. 14 (1940)]. Using an exponential type wavefunction for the trapped electron and (*a*) a simple, (*b*) a modified spherical potential well the interaction energies between the defect electron and lattice ions are calculated by a variational method. Only in case (*b*) can the results be made to agree with the experimental facts about the absorption bands in alkali halide crystals. P. T. LANDSBERG

537.311.33 : 539.1

5831. Interaction between electrons and ions in semiconductors. II. R. KUBO. *J. Phys. Soc. Japan*, **4**, 322–5 (*July–Dec.*, 1949).

The methods and equations of an earlier paper [see preceding Abstr.] are used and generalized to the case where defects having positive charge ze ($z = 0, 1, 2$) trap one or two electrons. The calculation is based on an assumed space charge density distribution due to the displacement of the lattice ions, and, in the case of the two electron systems, on the approximate wavefunction $A \exp[-a(r_1 + r_2)]$. Sources of inaccuracies in the calculation are: (1) the lowering of the energy levels due to the lattice structure is neglected; (2) owing to the nature of the assumed wavefunction the electronic energies are underestimated. It is pointed out that in the recent work by Mott [Abstr. 2068 (1950)] the displacement of the ions has not been sufficiently considered. P. T. LANDSBERG

537.311 : 539.1

5832. Interaction between electrons and ions in semiconductors. III. R. KUBO. *J. Phys. Soc. Japan*, **4**, 326–9 (*July–Dec.*, 1949).

Energy diagrams for the various types of lattice defects (univalent or divalent defects, one or two trapped electrons) in KCl are given according to relations established earlier [previous Abstr.]. The diagrams are interpreted with reference to experimental data, and the energy of a self-trapped electron is estimated. The value obtained is half as big as the thermal energy (0·13 eV) found by Markham and Seitz [Abstr. 653 (1949)], who took the lattice structure into account. P. T. LANDSBERG

537.311.33 : 548.0

33. Enhancing of electron currents in irradiated ystals. R. W. POHL AND F. STÖCKMANN. *Ann. ys., Lpz.*, **6**, 89–92 (1949) *In German.*

The observed enhancing of electron currents in adiated semi-conducting crystals is determined by e lifetime of the freed electrons and not by the rticular conduction mechanism. Crystals irradiated th energetic particles or with γ-rays show similar haviour to that observed many years before using sible and u.v. irradiation. G. F. J. GARLICK

537.311.33 : 548.0

34. Secondary currents in coloured KCl crystals. . P. KALABUKHOV AND N. G. POLITOV. *Dokl. Akad. uk, SSSR*, **70** (*No.* 5) 805–8 (1950) *In Russian.*

The temperature variation of the discharge olarization) currents has been studied. Crystals ere coloured by the method of Artsybashev; each ystal was illuminated (in an electric field) for 10 sec, nereupon the light was turned off and the crystal nultaneously earthed. The discharge current was easured 1 sec after both the light and the field were rned off. It has been found that coloured KCl ystals show dark conduction at temperatures at hich transparent crystals do not show any dis- rnible conduction. It has been suggested that any nduction observed at temperatures below 125°C of an electronic nature, viz. the colouring of KCl ystals entails the formation of neutral K atoms, lloidal particles and K_2 molecules. Some of the ectrons may be captured by these K_2 molecules. is probable that, in accordance with the conceptions Frenkel (and Pohl), the *F*-centres (colour centres) e neutral atoms of the alkali metal resulting from e additive colouring of KCl. Negatively charged $_2$ molecules dissociate into K and K^- or into 2K id an electron. The release of this electron is the use of dark currents in coloured KCl crystals.

F. LACHMAN

537.311.33 : 621.315.59

35. Background noise in semi-conductors. II. . F. MATARÉ. *J. Phys. Radium*, **11**, 130–40 (*March*, 50) *In French.*

The author's formulae for noise levels in semi- nductors with a.c. signals applied are extended to rious semi-conductive devices such as frequency ixers and transistors [see Abstr. 2451 (1950)].

C. A. HOGARTH

537.312.5

36. Investigation of the kinetics of the photo- nductivity by a compensation method. V. E. LASH- AREV AND I. R. POTAPENKO. *Izv. Akad. Nauk, SSSR, er. Fiz.*, **13** (*No.* 5) 566–73 (1949) *In Russian.*

The alternating photo-current bridge used permits measuring the complex photo-current of the photo- sistance under test at varying frequencies of the odulated light, separating its real and imaginary rts and representing the results on a (I_x, I_y)- agram, convenient for interpretation. Such dia- ams give a good idea of the characteristic periods the carriers of the photo-current. For the speci- ens investigated these lie between $2{\cdot}8\times10^{-5}$ and $\times10^{-5}$ sec. The specimens were PbS, Tl_2S and g_2S. B. F. KRAUS

537.312.5

5837. Conductivity changes in cadmium sulphide crystals due to X-ray irradiation. J. FASSBENDER AND O. HACHENBERG. *Ann. Phys., Lpz.*, **6**, 229–31 (1949) *In German.*

Photoconductivity in CdS crystals due to X-ray irradiation is studied. The photocurrent produced is proportional to the energy of absorbed quanta over the range investigated (20–65 keV). G. F. J. GARLICK

537.312.5

5838. On the inner photo-effect of cuprous oxide. T. OKADA AND R. UNO. *J. Phys. Soc. Japan*, **4**, 351–2 (*July–Dec.*, 1949).

Tempering in an O_2 atmosphere increases the peak value of the photoconductivity at 6 000 Å. Heating and annealing in vacuum results in an increase of the photoconductivity at 8 000 Å while that at 6 000 Å is reduced. The photocurrent is a maximum at about 210°C (for 8 000 Å) and a much higher peak output is reached for 6 000 Å at much lower temperatures.

W. SUMMER

537.312.5 : 535.37

5839. The photovoltaic behavior of organic substances in solution. I. LEVIN AND C. E. WHITE. *J. Chem. Phys.*, **18**, 417–26 (*April*, 1950).

A number of organic compounds has been studied for a comparison of photovoltaic behaviour and fluorescent properties. No definite correlation could be found between visual fluorescence and the photovoltaic response. The photopotentials were measured by using a Pt point as the irradiated electrode connected to a vacuum tube electrometer. The irradiated electrode is assumed to act as a collector in the "space charge" of the photoactive molecules. Both positive and negative photopotentials were obtained. Compounds possessing a carbonyl group adjacent to an aromatic nucleus invariably produced a positive photopotential. A.

537.312.5 : 537.311.33

5840. Influence of electric field on photo-e.m.f. in insulated semiconductor. V. E. LASHKAREV. *Dokl. Akad. Nauk, SSSR*, **70** (*No.* 5) 813–16 (1950) *In Russian.*

The author's theoretical considerations are upheld by Putseĭko [*Dokl. Akad. Nauk, SSSR*, **67**, 1009 (1949)], who reported that on 11 types of semi-conductors external electric field causes increase of photo-e.m.f. irrespective of polarity of the field, but on 18 types the polarity of the field determined whether the photo-e.m.f. was increased or decreased. In all cases where the character of conductivity of semiconductor was known the polarity of external voltage [field] giving higher value of photo-e.m.f. coincided with the sign [polarity] of dark carriers of current, and hence the effect may be utilized to determine such polarity. J. LUKASZEWICZ

537.312.5 : 548

5841. On the photo-electric sensitization of CdS. W. VEITH. *C.R. Acad. Sci., Paris*, **230**, 947–9 (*March* 6, 1950) *In French.*

An excess of Cd in the CdS lattice modifies the electrical qualities of the photo-electric layer. The photosensitivity is destroyed by heat treating the CdS layer in S, while heating in Cd improves the sensitivity of the layer. Diffusing Cu into the crystal

lattice of CdS (at 350°c) shifts the sensitivity max. from 5 000 Å to 6 000 Å, while Ag shifts it to 5 450 Å. The yellow CdS layer is tainted red by the Cu, but pink by the Ag admixture. The photo-electric effect disappears with the disappearance of any excess Cd in the lattice. W. SUMMER

537.312.6

5842. The electrical resistivity of shales and coals on heating. A. A. AGROSKIĬ AND I. G. PETRENKO. *Izv. Akad. Nauk, SSSR, Otdel. Tekhn. Nauk*, 89–100 (*Jan.*, 1950) *In Russian.*

The resistivity (ρ) of coals and shales measured by methods described in earlier papers [A. A. Agroskiĭ and I. G. Petrenko, "Determination of electrical resistivity of coals and shales on heating," *Zavodskaya Laboratoria* (*No.* 7) (1948); also "Electrical resistance of coals," *Izv. Akad. Nauk, SSSR, Otdel. Tekhn. Nauk* (*No.* 7) (1948)] drops from 10^{10} ohm cm to 10^2 ohm cm between room temperature and 900°c. The drop is largely caused by artificial carbonization of the material. The results are approximate and are affected by experimental conditions, particularly rate of heating and temperature gradient. Below 100°c the presence of water contaminated by mineral salts reduces ρ greatly, ρ rises as the water dries out at temps. >100°c and at higher temps. ρ falls in a characteristic manner. Anthracite, being highly carbonized, has a low value of ρ. At low temperatures the ρ of limestone is of the same order as that of shale and the effect of water content is similar, but at high temperatures the ρ of limestone is greater than that of shale. W. R. STOKER

537.312.6 : 538.221

5843. Refinements and new results on the variation with temperature of the electrical resistance of ferromagnetic materials. G. MANNEVY-TASSY. *C.R. Acad. Sci., Paris*, **230**, 1150–2 (*March* 20, 1950) *In French.*

The electrical resistance of Ni has been measured as a function of temperature. Using reduced co-ordinates the results are compared with similar data for other ferromagnetic materials, agreement being obtained for Fe and Ni but not for MnSb.

A. E. DE BARR

537.312.62

5844. On the carriers of electricity and heat in superconductors. Z. MIKURA. *J. Phys. Soc. Japan*, **3**, 338–42 (*Sept.–Dec.*, 1948).

On the basis of the generally accepted concepts on metallic conduction and the structure of the intermediate state it is argued that a carrier in a superconductor has a very large electric charge compared with the ordinary electron and a large mass proportional to the charge. The inference is that the electrons in a metal begin to condense (not necessarily in co-ordinate space, but rather in momentum space) into droplets as soon as superconductivity takes place in the metal, and that each droplet behaves like a "giant electron." H. G. SOLOMON

537.312.62 : 531.19

5845. A statistical mechanical treatment of conduction electrons: an attempt to the theory of superconductivity. H. ICHIMURA. *J. Phys. Soc. Japan*, **4**, 265–70 (*July–Dec.*, 1949).

It is assumed that for metals for which the Brillouin zones overlap and the Fermi surface falls into th domain the inter-electronic interactions are mc important for electrons near the Fermi surface. F these a co-operative interaction of the Bragg Willian type is assumed, i.e. the interaction energy per electr is assumed proportional to the number of electro occupying special levels above the normal Ferr distribution. The nature of this energy is not di cussed and the proportionality constant arbitrari chosen. On this basis the thermodynamical potenti and the specific heat are calculated and found represent correctly the behaviour of superconducto near the critical temperature. H. LONDO

537.312.62 : 538.1

Conservation of flux by a superconducting toru *See Abstr.* 5949

537.312.62 : 538.2

5846. Magnetic properties of a rotating super conductor. A. WEXLER AND W. S. CORAK. *Phys. Rev* **78**, 260–5 (*May* 1, 1950).

The magnetic properties of a superconductive P sphere have been studied through the measuremen of the voltage induced between the axis and th periphery of the sphere rotated as a Faraday disc constant speed in an axial magnetic field. Measure ments were made in the range 0–10 800 r.p.m. Th data are consistent in all details, including critica field and the amount of frozen flux, with the propertie of the stationary sphere. In the course of this work it was found that films of colloidal graphite serve a useful resistance thermometers in the liquid He range A

537.312.

5847. The effect of cold working on the electrica resistivity of copper and aluminum. J. W. RUTTER AN J. REEKIE. Letter in *Phys. Rev.*, **78**, 70–1 (*April* 1 1950).

537.312.

5848. A study of the effect of tension on the electrica resistance of alloys. I. J. O. LINDE, A. VON HEIJN AND E. VON SABSAY. *Ark. Fys.*, **2**, *Paper* 10, 81–7 (1950).

The dependence of strain on resistance has been determined for some Cu and Ag alloys, and their Young's modulus measured. A

537.312.9

5849. A study of the effect of tension on the electrical resistance of alloys. II. J. O. LINDE AND C. H. STADE *Ark. Fys.*, **2**, *Paper* 12, 99–103 (1950).

The dependence of strain on resistance and some other physical properties has been studied for a number of alloys. Detailed studies have been made on the alloy series Ag–Mn and Au–Cr. The Ag–Mn alloys which are characterized by a high value of the resistance-pressure coefficient show no correspondingly high value of the resistance-stress coefficient. Analogous results are, according to earlier measurements, valid for manganin. The regularities found indicate that the fairly low value of the resistance-stress coefficient is a consequence of the fact that deformation by tension is connected with an increase in volume, resulting in different signs for the change of resistivity and the change of resistance due to the change of geometrical dimensions of the sample of the alloys mentioned. A

537.32 : 536.7

50. The thermodynamics of thermo-electricity. E. VERSCHAFFELT. *Bull. Acad. Roy. Belg. Cl. Sci.*, (*No.* 1) 26–46 (1950) *In French.*

Kelvin's classical theory is reviewed and criticized. ıe author applies his analysis to the case of a ermojunction consisting of 2 alloys, and points out consistencies in the theory of Meixner. Abstr. 4794 949); *Ann. Phys., Lpz.*, **35**, 701–34 (1939).

C. A. HOGARTH

537.36

51. Migration of sodium ions through quartz ates in an electric field. I. R. C. VOGEL AND G. IBSON. *J. Chem. Phys.*, **18**, 490–4 (*April*, 1950).

The kinetics of the migration of Na ions through ystalline quartz plates have been studied. This igration, which was induced by an electric field, is sumed to take place through tunnels inherent in the ystal structure and parallel to the principal axis of e quartz. It was shown that the only important echanism of current flow is the migration of Na ns through the quartz plate. The activation energy from 22 to 25 kcal. and depends upon the potential adient. The rate of migration of the Na ions is sentially independent of the concentration of the a ions. A.

537.365 : 534.321.9

52. On the attenuation of alternating electro-netic quantities with frequency. J.-P. CAUSSE. *.R. Acad. Sci., Paris*, **230**, 826–7 (*Feb.* 27, 1950) *French.*

In 1933, Debye demonstrated that a p.d. exists etween the nodes and anti-nodes of ultrasonic waves an electrolyte. In the present tests a magneto-riction generator is used for the range 8–80 kc/s nd a calibration curve is obtained with distilled ater, the p.d. throughout this range being constant 10 μV. A suspension of fine sand gave a curve milar to that of the distilled water, but with colloidal ver the p.d. fell appreciably at approximately) kc/s and dropped to the limit of sensitivity of the ceiver at 70 kc/s. It is stated that these results fit ermans' theory. A. C. WHIFFIN

ELECTRIC DISCHARGES 537.52

537.52

353. On the mechanism of electrical erosion of etals. S. L. MANDELSHTAM AND S. M. RAĬSKIĬ. *v. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 5) 549–65 949) *In Russian.*

The hypothesis that the erosion of the metals is a condary process due to the destructive action of the rches on the opposite electrode is supported experi-entally. An essential condition of this effect is the ovement of the torches with a super-critical speed. here is evidence testifying to a high pressure existing this kind of torch. Torches moving at sub-critical eeds have different characteristics and effects.

B. F. KRAUS

537.52

5854. A variable frequency electronic interrupter for the direct current arc. R. J. DWYER. Letter in *J. Opt. Soc. Amer.*, **40**, 180 (*March*, 1950).

537.52

5855. Study of condensed discharges in gases (xenon). Oscillographic method. M. CLOUPEAU AND R. LEGROS. *C.R. Acad. Sci., Paris*, **230**, 1347–9 (*April* 3, 1950) *In French.*

The time variation of the intensity in narrow wavelength bands of radiation emitted by discharges, has been studied using a photomultiplier cell, amplifier and oscillograph and sparking equipment described by M. Laporte ("Les Lampes à éclairs lumière blanche et leurs applications," Paris, 1949). Experimental results and details are briefly summarized. The method is more sensitive than photographic recording using a rotating mirror. J. H. MASON

537.521.7

5856. Avalanche transformation during breakdown in uniform fields. G. M. PETROPOULOS. *Phys. Rev.*, **78**, 250–3 (*May* 1, 1950).

The transformation of the avalanche into an anode-directed streamer is considered in the case of uniform field gaps, submitted to minimum breakdown voltage.

A.

537.521.7

5857. The measurement of spark channel diameters. R. F. SAXE AND J. B. HIGHAM. Letter in *Proc. Phys. Soc., Lond. B*, **63**, 370 (*May*, 1950).

537.523

5858. The electric breakdown in pure helium at low temperatures. B. M. GOKHBERG AND M. F. BUKHINA. *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 1) 27–8 (1950) *In Russian.*

Electric breakdown has been investigated in gaseous He at very low temperatures: 2·57, 3·4, 4·2 and 20·4°K. A linear breakdown-voltage/pressure relationship has been found for each temperature. When re-calculated for densities, only one breakdown-voltage/density linear relationship is obtained. For $p = 760$ mm Hg and $t = 20$°C, the breakdown-voltage value of $E = 1{\cdot}93$ kV/cm atm. has been extrapolated. This is a much smaller value than that obtained by other authors, and it is suggested that the higher values were due to contaminations.

F. LACHMAN

537.523.5 : 536.55

5859. On the temperature of the anode crater in high current pure carbon arcs. J. EULER. *Z. angew. Phys.*, **2** (*No.* 3) 115–17 (1950) *In German.*

Discusses spectroscopic methods of measuring anode flame and crater temperatures ($\sim 4\,000$°K for the cases considered), and gives details of some measurements. J. D. CRAGGS

537.525

5860. Studies of the Joshi-effect in chlorine under ozonizer excitation—influence of temperature. K. S. VISVANATHAN AND K. KUPPUSWAMY. *Indian J. Phys.*, **24**, 13–18 (*Jan.*, 1950).

The influence of temperature in the range 8°–67°c on the magnitude of the Joshi-effect in Cl in the pressure range 55·5–390 mm and excited in a Siemens' ozonizer due to potentials of 50 c/s frequency

has been studied. The magnitude of both the net as well as the relative effect decreases with increase of temperature; the influence of applied potential is to increase the net effect and decrease the relative effect. This inhibitive influence of temperature is more in evidence at lower than at higher applied potentials. The anti-correspondence between light absorption by Cl which increases, and the Joshi-effect, which decreases with increase of temperature, is in accord with Joshi's view that Δi is not entirely a consequence of selective light absorption by the excited gas but rather a quantum or frequency effect. A.

537.525

5861. De-ionization of hydrogen at low pressures. S. N. GAVRILOV. *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 2) 265–8 (1950) *In Russian.*

An account of the de-ionization process, studied electrically by a method derived from that used by W. Koch and V. L. Granovsky, is illustrated diagrammatically. The latter's equation for the course of de-ionization was used to obtain curves (illustrated) for a given set of conditions, thus enabling the required quantities to be calculated. Granovsky's theory of hydrogen de-ionization was vindicated as against that of Spenke and Steenbeck, which had been supported by Wasserraab [*Wiss. Ver. Siemens*, **15**, 19 (1940)] and Pachner [Abstr. 3236 (1949)]. The time figure quoted by the latter theory is almost 30 times as great as that actually observed in the experiment here reviewed. A scheme is also described and illustrated diagrammatically for the study of the potential of the recurrent inflammability of H. It is claimed that by the process indicated the dependence of the initial time of de-ionization upon H pressure is proved. Some results of the experiments made are shown graphically. The method also enables measurement to be taken of the time required to develop de-charging. J. CLEUGH

537.525.3

5862. Photon pulses from point-to-plane corona. W. N. ENGLISH. Letter in *Phys. Rev.*, **77**, 850 (*March* 15, 1950).

537.525.5

5863. Investigations on the motion of the cathode-spot of a low-pressure mercury-vapour arc. E. SCHMIDT. *Ann. Phys., Lpz.* (*Folge* 6) **4** (*No.* 5) 246–70 (1949) *In German.*

High-speed cine-camera photographs (3 000 frames/sec) of the cathode show that at high current-densities, the discharge takes place from a number of separate spots: each spot carries a mean current of about 6·7 A. The motion of the spot consists of a random Brownian movement superposed on a general trend in the direction of shortening the discharge path to the anode. Assuming that the general trend is due to the action of a force = grad $\phi(x, y)$ where ϕ is a potential field and x, y the co-ordinates of a point on the cathode, the density of cathode spots n is of the form $n_0 \exp [\phi(0, 0) - \phi(x, y)]/kT$ where n_0 is the spot-density at the point (0, 0), k is Boltzmann's const. and T a temperature corresponding to the random motion. It is found that the spot-density distribution is not of this form for a 2-dimensional cathode of the usual type, but that experiment and theory nearly agree for a linear cathode (one mu longer than it is wide). A. SCHOFIEL

537.525

5864. The behaviour of the cathode spot on a undisturbed liquid surface of low work functio K. D. FROOME. *Proc. Phys. Soc., Lond. B*, **63**, 377–8 (*June*, 1950).

The cathode spot of transient arcs using the liqui Na–K alloy for cathode has been studied by mean of the Kerr cell apparatus capable of taking a sequenc of photographs. It is found that for a given curren the spot takes, as in the case of Hg, the form of line or broken line of total length roughly proportiona to the current. This is also true for a spot in magnetic field. Again as for Hg, if the current rise slowly the length of line increases proportionally t the current. If the rate of growth of current is greate than a value lying approximately between 10^8 an 2×10^8 A/sec, then fresh spots form and sprea out radially from the point of formation into thi semicircular or circular lines moving with a maxi mum radial velocity of about 10^4 cm/s. The apparen current density of emission lies between 2·5 and 5×10^6 A/cm^2, and consequently is higher tha for Hg. A

537.525.5

5865. Probe measurements for high frequency discharge. S. KOJIMA AND K. TAKAYAMA. *J. Phys. Soc. Japan*, **4**, 349–50 (*July–Dec.*, 1949).

Describes expts. with a 2-probe system in 200 Mc/s discharges in A at pressures of 1–10 mm Hg. Values for electron temps. (~ 20 000°K) are given for a particular discharge operated at 7 mm Hg pressure. J. D. CRAGG

537.525.9/.95

5866. Plasma and Langmuir sheath. Theory of probes in gas discharges. F. WENZL. *Z. angew. Phys.*, **2** (*No.* 2) 59–75 (1950) *In German.*

The well-known simplifying assumptions of the Langmuir theory of probes in electrical gas discharges led in many cases to fundamentally incorrect values for the mean kinetic energies of the ions; but the usual measurements of the mean electron energies are not affected by these simplifications, and measurements of plasma potentials only slightly. On the assumption that sheath thickness is at most equal to probe radius and the latter small compared with the free path, an exact investigation of the positive and negative saturation currents to spherical probes gives insight into the potential changes, and also the ion and electron concentrations, even outside the sheath. The case of cylindrical probes is considered and disagreements between probe theory and experiment are explained. General ideas concerning the transition from plasma to sheath are clarified.

F. LLEWELLYN JONES

537.527.5

5867. On the pressure-dependence of the continuum in the high pressure mercury arc. G. BUSZ AND P. SCHULZ. *Ann. Phys., Lpz.*, **6**, 232–40 (1949) *In German.*

Measurements at 6 and 10A, and between 16 and 36 atmos., showed that the continuous radiation could be expressed as the sum of terms proportional to the

and 1·75 power of the pressure respectively. first term results from recombination radiation, ich is favoured by high current density and low ssure; the second term is attributed to collision iation, which predominates at low current density high pressure. The measurements were made at ervals between 4 600 and 12 000 Å, and showed o that at any pressure the proportion of recom- ation radiation increases as the wavelength reases. S. T. HENDERSON

X-RAYS 537.531

537.531

58. White rays on the long wavelength side of the discontinuity for X-rays of oxides of the corundum e. C. KURYLENKO. *Cah. de Phys.* (*No.* 34) 37–48 *arch*, 1950) *In French.*

The phenomenon is described and explained in ms of the transition of an electron from a $K, L, \ldots$ el to a level of a new type, representing a free ctron in the crystal lattice, whose energy is deter- ned by the interaction of the de Broglie wave asso- ted with it and the crystal lattice. The shape of density of blackening curve is calculated for ematite, Fe_2O_3, on these assumptions and the sition of its max. and min. agree to a first approxi- tion with the observed values; discrepancies are arded as due to neglect of the correction term ε the equation $n\lambda - 2d\cos\theta = \varepsilon d^2\lambda$.

R. B. SHEPHERD

537.531 : 535.33

59. Study of the *L* spectrum emitted by mercury pour. L. GROVEN AND A. LAGASSE. *Bull. Acad. y. Belg. Cl. Sci.*, **35** (*No.* 12) 1065–72 (1949) *In nch.*

Hg vapour was excited by a Tesla discharge of kV and the resulting soft X-rays photographed in uchois spectrographs, the plates being micro- otometered. About 90 lines between 1 269 and 1 X.U. are tabulated with their ν/R and $\sqrt{(\nu/R)}$ ues, and compared with those recorded by uchois (1935). About half the lines are new and classified. Variations in relative line intensities exemplified from the spectra of solid HgS and the pours of Hg and $HgCl_2$. S. T. HENDERSON

537.531 : 535.33

70. Note on the study of the *K* spectrum of seous Br^{35}. J. MORLET. *C.R. Acad. Sci., Paris*,), 942–4 (*March* 6, 1950) *In French.*

The author gives a table of the fine structure of *K* spectrum and discusses the origin of the α d β satellites. R. B. SHEPHERD

537.531 : 535.33

71. The *L–M* and *K–M* discrepancies in the rare ths. E. A. STEWARDSON AND H. F. ZANDY. tter in *Proc. Phys. Soc., Lond. A*, **63**, 670–1 (*June*, 50).

537.531 : 535.339

72. Image formation by means of X-rays. Y. CAUCHOIS. *Rev. Opt.* (*Théor. Instrum.*) **29**, 151–63 (*March*, 1950) *In French.*

Optical images can be produced using X-rays and distorted crystals, either as mirrors or lenses, following the methods used for producing monochromatic X-rays of high intensity. The crystal may serve as its own monochromator, but greater freedom is obtained by using a separate monochromator. At this stage, the quality of the images is not sufficient to allow of any appreciable magnification and the author considers that further work should be directed towards a perfection of the technique of preparing the optical elements. X-ray images of the focal spots of X-ray tubes and of certain objects in transmission are shown. W. F. BERG

537.531 : 535.4

5873. Contribution to the study of the X-ray microscope. II. L. BRÚ AND M. CUBERO. *An. Real Soc. Esp. Fis y Quim.*, **45A**, 421–34 (*Sept.–Oct.*, 1949) *In Spanish.*

The texture of a fabric was determined by diffraction experiments analogous to X-ray diffraction experiments on crystals. L. PINCHERLE

537.531 : 535.42 : 548.732

5874. Calculation of the correction for instrumental broadening in X-ray diffraction lines. M. S. PATERSON. *Proc. Phys. Soc., Lond. A*, **63**, 477–82 (*May*, 1950).

A new numerical procedure, based on relaxation methods, for calculating the correction has been evolved. The corrected integral breadth and the true line profile are obtained without restrictive assumptions. The calculations for a practical example are given. A.

CATHODE RAYS . POSITIVE RAYS 537.533/.534

537.533.72 : 621.385.833

5875. The electron optics of a magnetic lens of the Glaser type. J. SCHLÖGL. *S.B. Öst. Akad. Wiss., Abt. IIa*, **157** (*No.* 6–10) 237–62 (1949) *In German.*

The Glaser lens has a field given by $H_{(z)} = H_0[1 + (z/a)^2]^{-1}$. The present work treats a generalized case in which $H_{(z)} = H_0[1 + (z/a)^2]^{-\mu}$, $\mu = 1, 1{\cdot}5, 2, 2{\cdot}5, 3$, etc. This leads to a differential equation of Hill type which has been solved by Svartholm [Abstr. 2451 (1944)] by an infinite series. An integral equation solution is given and the results are found to agree with the earlier ones. The problem of calculating the field required to give specified focal lengths, etc., is then treated as an eigenvalue problem which is solved by the Rayleigh–Ritz method.

A. H. W. BECK

537.533.74

5876. On the infrared catastrophe in the problem of electron scattering. T. SEBE. Letter in *Progr. Theor. Phys.*, **3**, 95–6 (*Jan.–March*, 1948).

537.533.74

5877. Some simple considerations on the back diffusion of fast electrons. W. BOTHE. *Ann. Phys., Lpz.*, **6**, 44–52 (1949) *In German.*

The back-scattering of fast electrons of given

initial energy by a thick sheet of matter, and the fraction scattered with various energies, are calculated. The results for electrons scattered with low energies are in good agreement with experiment. The strict diffusion theory is applied to investigate part of the complete back diffusion processes, and the maximum of the energy distribution curve is obtained satisfactorily. The influence of single scattering is briefly discussed. F. LLEWELLYN JONES

537.533.74 : 538.114

5878. On the magnetic scattering of fast electrons in the ferromagnetic crystal. T. MUTŌ, K. INOUE AND I. WATANABE. *J. Phys. Soc. Japan*, **4**, 251–7 (*July–Dec.*, 1949).

Theoretical. Discusses the possibility of observing electron polarization by measuring the transmission of an electron beam through iron, with and without magnetization. J. THEWLIS

537.533.8

5879. Secondary emission from alloys. H. SALOW. *Ann. Phys., Lpz.*, **5** (*No.* 6–8) 417–28 (1950) *In German.*

The 2-component alloys of Ag and Cu with Mg, Al and Be were studied. The surfaces were prepared by simultaneous evaporation in vacuum and subsequent forming. The results agreed with those obtained for ordinary melted alloys. Treatment with O_2 gave values of $\delta \simeq 10$ at 500 V. The materials are stable and are not poisoned by dry, CO_2-free, gases. Cu–Mg gave $\delta_{max} \simeq 13$ at 1 000 V, Cu–Al $\delta_{max} \simeq 10$ at 500 V, Ag–Be $\delta_{max} \simeq 7$ at 600 V, Cu–Be $\delta_{max} \simeq 4$ practically constant from 500–1 200 V. The value of δ decreases as the temperature of the layer increases. The phenomena are explained as follows, the forming with O gives rise to areas of insulating or semi-conducting crystals and a consequent reduction of absorption of secondaries on their way to the surface. Raising T increases the number of free electrons in these areas with consequent increase in number of collisions and diminution of δ. The emitter has therefore the character of a semiconductor. A. H. W. BECK

537.534.72

5880. Focusing properties of a generalized magnetic spectrometer. D. L. JUDD. *Rev. Sci. Instrum.*, **21**, 213–16 (*March*, 1950).

The first-order focusing properties of a magnetic spectrograph similar to that of Siegbahn and Svartholm, but differing in that both source and collector lie outside the field, are investigated. The parameters of the analogous thick lens optical system are derived. General expressions for image distance, astigmatism, magnification, solid angle, dispersion and resolution of lines with a spread in momentum are obtained. Factors affecting the compromise between intensity and resolution are discussed. The possibility of increasing resolution without loss of intensity by introducing some astigmatism is considered. Second-order effects have not been included since they are thought to be of the same order as corrections for the fringing field. The first approximation proved adequate for the design of an instrument in which satisfactory focusing was obtained by simple empiric adjustments.

537.534.

5881. The mass spectrometer. K. E. BURMAST AND E. C. EVANS. *Instruments*, **23**, 242–5 (*Marc* 1950). Review article: 31 refs.

537.534.

5882. The scattering of high energy charge particles by thin foils of matter. S. T. BUTLE *Proc. Phys. Soc., Lond. A*, **63**, 599–605 (*June*, 1950)

The distribution of high energy charged particl scattered by a thin foil has been investigated an compared with the formula for single scattering. is shown that at sufficiently large angles the distr bution approaches that for single scattering and ca be expressed in the form of a rapidly converge series of which the first term is identical with th single scattering formula. The remaining terms c the series form an accurate expression for the devia tion from true single scattering. The simplified cas of projected scattering has also been considered. A

537.534.7

5883. The angular distribution of synchrotro target radiation: a preliminary experimental study J. D. LAWSON. *Proc. Phys. Soc., Lond. A*, **63**, 653–6 (*June*, 1950).

The angular distribution of radiation from a synchrotron has been measured with an ionizatio chamber for a number of different target materials and thicknesses, and the results have been compare with a simple theory in which the radiation from a parallel beam of electrons striking a thin plate has been calculated. Detailed comparison with theory is not possible, because the precise way in which the electrons hit the target cannot be determined; never theless qualitative explanations have been found fo most of the effects observed. The most important o these is the relative insensitivity of forward intensity and beam width to target size and material. A

537.534.74 : 537.56

5884. Elastic scattering and neutralization of low velocity hydrogen ions in normal butane and isobutane. J. H. SIMONS AND W. H. CRAMER. *J. Chem. Phys.*, **18**, 473–7 (*April*, 1950).

The low velocity scattering of H^+, H_2^+ and H_3^+ in both normal and isobutane has been measured at ion velocities of less than 150 V. Ion neutralization was detected and measured for all 3 ions in both hydrocarbons. The potential functions between the ion and molecule as evaluated from the elastic scattering have been obtained for all 3 ions in both hydrocarbons. For H^+ these functions in both hydrocarbons have the same form with the same values of the exponent over the same range of distance. The force constant, however, is considerably greater for the branch chain compound. For certain ranges of distances the potential functions of the 3 different ions in both of the hydrocarbons show values of the exponent less than 4. For substances possessing no permanent dipole similar results have previously been obtained only in those cases where there is a potentiality of chemical combination. A

DISCHARGE TUBES . COUNTERS 537.54

537.542

35. Investigations on a magnetic ion source. I. KISTEMAKER AND H. L. D. DEKKER. *Physica*, **16**, 3–208 (*March*, 1950).

An ion source of the magnetic type has been veloped, using oscillating electrons, and with the ument quite near the ion extraction hole. Space-arge-limited ion currents have been obtained ging from 5 to 10 mA using extraction potentials 6 to 15 kV. H_2, He and N_2 gas have been used, owing an apparent mass effect. No influence of pressure on the extracted ion current was ex-ienced in the pressure region from 10^{-5} to $^{-3}$ mm Hg. An experimental comparison between source and the usual type has been carried out d the ion outputs show only small differences. A.

537.542

36. Investigations on a magnetic ion source. II. KISTEMAKER AND H. L. D. DEKKER. *Physica*, **16**, 9–20 (*March*, 1950).

It is shown that the electrons in a magnetic ion urce can experience up to 48 oscillations in He gas fore being caught by the anode cylinder. This rresponds with a mean pathlength of 1 200 cm, d gives rise to electron and positive ion densities the discharge of the order of 10^{10} per cm^3. The gree of ionization is 0·1%. The influence of the essure on the ion-production mechanism as well the economy of the source are discussed. From to 80% of the gas is used effectively for ion output the source, and only 0·05 W energy input per ion current is needed on the target. A discussion the ion extraction mechanism explains the high h currents in comparison with other types of ion urces. A.

537.542

37. Discharge mechanism of Geiger–Müller unters. I. The motion and quantity of positive ions. KUMAGAI, K. SHIMODA, I. OGAWA, Y. TORIKAI D T. KODAMA. *J. Phys. Soc. Japan*, **4**, 39–44 *n.–Feb.*, 1949).

Describes expts. carried out in 1943 on self-quenched e counters. Oscillographic observations of pulses described and are interpreted in terms of ion-eath movement and from them ion mobilities are duced for argon/ethyl-alcohol mixtures. Dead-nes were observed and measurements of pulse size *v.* ervoltage were made which lead to an explanation the inflection in the pulse-size/overvoltage curve. pts. with a tube counter incorporating a grid are o included. J. D. CRAGGS

537.542

38. Discharge mechanism of Geiger–Müller unters. II. Experiments with a separated cathode unter. H. KUMAGAI, K. SHIMODA, I. OGAWA, TORIKAI AND T. KODAMA. *J. Phys. Soc. Japan*, **4**, -8 (*Jan.–Feb.*, 1949).

Describes expts. on discharge propagation in self-enched tube counters. Data on (*a*) the extent of charge spread in a divided-cathode tube and (*b*) on the velocity of propagation of the discharge are given, and compared with results due to other workers. (*b*) was measured by displaying on a c.r.o., as *x*- and *y*-sweeps, pulse voltages derived from separate cathode cylinders at each end of the tube. Values of propagation velocities varying between 4×10^6 and $1{\cdot}2\times10^7$ cm/s were obtained. J. D. CRAGGS

537.542

5889. Discharge mechanism of Geiger–Müller counters. III. Origin of the "Nachentladung." H. KUMAGAI, K. SHIMODA, I. OGAWA, Y. TORIKAI AND T. KODAMA. *J. Phys. Soc. Japan*, **4**, 48–51 (*Jan.–Feb.*, 1949).

Describes expts. with tube counters containing 2 or 3 coaxial electrodes on the time of appearance and relative numbers of spurious counts. This paper gives a short summary of conclusions reached in the series of 3 papers and gives references to recent Japanese work. [See Abstr. 5887 (1950)].

J. D. CRAGGS

537.542

5890. On the temperature dependence of counter characteristics in self-quenching Geiger–Müller counters. OM PARKASH AND P. L. KAPUR. *Proc. Phys. Soc., Lond. A*, **63**, 457–61 (*May*, 1950).

Counters with internal (A) and external (B) cathodes were investigated from 8° to 60°C. The average counting rate remains independent of temp., and this constancy is better for B than A. As counter A shows a greater increase in slope at higher temperatures, the rate appears to be greater at higher applied potentials. Further, the plateau of A decreases and disappears at lower temperatures, while B does not show this effect. This is partly explained by the formation of semi-conducting paths between the central wire and the cathode in A, the discharges along which give rise to spurious counts. The slope of the plateau increases and the width decreases with rise of temperature in both cases, though the increase is more marked with A. It is probably due to the presence of a greater number of multiple discharges or spurious counts at higher temperatures. The investigation brings out the advantage of the external cathode, especially when reliable observations are desired under widely changing temperature conditions. A.

537.542

5891. Time lags in Geiger counters. A. R. LAUFER. *Rev. Sci. Instrum.*, **21**, 244–51 (*March*, 1950).

Light from a spark was used to produce a primary ionizing event in a Geiger counter by means of the photoelectric effect. The time lag between this event and the detection of the pulse on the counter wire was studied as a function of counter filling, pressure and overvoltage. The measured lags, ranging from tenths of μsec to many μsec, were used to calculate electron mobilities, sheath spread velocities and electron attachment coefficients. The lags appear to be the result of the transit time required by the initial electrons to move from their point of origin to the high field region, and the time required by the sheath to spread laterally along the wire and to move radially outward far enough to produce an electrical pulse which can be detected. A.

537.542

5892. A study of plateau slopes in self-quenching Geiger–Müller counters. S. C. BROWN AND C. MARONI. *Rev. Sci. Instrum.*, **21**, 241–4 (*March*, 1950).

A study of plateau slopes of self-quenching Geiger–Müller counters shows that no quenching vapour tested produced flat characteristics. On the assumption that the slopes were given by spurious counts arising from the gas discharge phenomena, a study was made of the controlling factors. Neither the quenching gas nor the vehicular gas +ve ions were found to be significant. A study of the −ve ions produced by molecular dissociation of the quenching gas at the cathode, and electron attachment in the body of the gas shows that these factors are directly correlated with the slopes of the plateau characteristics.

A.

537.542

5893. Induced discharge phenomena on the central wires of multiple Geiger counters. K. HASHIMOTO AND H. HAGIWARA. *J. Phys. Soc. Japan*, **4**, 355–6 (*July–Dec.*, 1949).

Describes expts. with a double counter containing 2 parallel wires mounted between parallel plane electrodes. The spread of the discharge at one wire to the counting region of the second wire was observed with and without various intervening obstacles (e.g. glass or quartz plates). J. D. CRAGGS

537.542

5894. A thoroid [toroidal] γ-counter with high solid angle for coincidence spectrometry. K. SIEGBAHN AND H. SLÄTIS. *Ark. Fys.*, **2**, *Paper* 2, 5–8 (1950).

A toroidal Geiger counter was developed in order to have a large effective solid angle ($\sim 2\pi$) for β–γ coincidence work, and to reduce distortion of the β-spectrum by back-scattering; the counter has a stable plateau of about 200 V, and the sensitivity is practically uniform over the whole volume.

A. O. STANESBY

537.542 : 621.387.424

5895. The development of end-window Geiger–Müller counter tubes. R. O. JENKINS. *Instn Elect. Engrs*, *Paper* 1012 (1950) 6 *pp*.

Commencing as a tube using a feather-edge type of copper-to-glass seal, one inch in diameter, with a copper-foil end window, the design was later modified to one more suitable for production on a larger scale, employing a standard Kovar/glass eyelet seal, all metallic joints being effected by means of soft solder. To permit the detection of slower β-particles a similar tube was developed with a Duralumin window of thickness 1 mil, which was soldered to an electroplated copper layer. The assembly process was subsequently simplified by use of a thermosetting plastic adhesive wax. For the detection of very slow β-particles it was necessary to use a mica window of about 0·25 mil thickness, and a suitable seal was devised for windows of this material. It was found that extreme purity of the filling gas and quenching vapour was unnecessary, and less rigorous pumping than that associated with most electronic tubes was also permissible, the most important factors in obtaining good tubes being cleanliness and freedom from loose particles and lint. A.

537.542 : 539.164.8

5896. Determination of alpha particle energies with scintillation counters. I. BROSER AND H. KALLMANN. *Ann. Phys., Lpz.* (*Folge* 6) **3**, 317–21 (1948) *In German.*

It was shown previously [Abstr. 5061 (1950)] that using large crystals of CdS–Ag energies of single α-particles could be determined with an accuracy of 5%. In general only a few crystals show such good performance. While large single crystals give best and most consistent results for single particles continuous α-irradiation can be detected with layers of powder-form phosphors of the ZnS type. A good linear relation is shown between the output light intensity and the energy absorbed from the particles.

G. F. J. GARLICK

537.542

5897. Further experiments on the parallel wire-and-plate type counter. K. HASHIMOTO, M. IMAI AND H. HAGIWARA. *J. Phys. Soc. Japan*, **4**, 176–7 (*May–June*, 1949).

Describes expts., with counters consisting of 3 parallel wires mounted between parallel plates, to measure the proportion of discharges that, starting at one wire, spread to other wires. Argon/alcohol mixtures were used as filling gases. Tests of spatial variations of sensitivity in the counters were also made. J. D. CRAGGS

537.542

5898. On the sensitivity time of the Wilson chamber. A. MURA. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **2**, 314–18 (*March*, 1947) *In Italian.*

By measurements on cosmic rays of known intensity the sensitivity time T was measured as a function of the expansion ratio R. The cylindrical chamber of 23·5 cm diameter and 8 cm depth was filled with air at the pressure of 59 cm Hg with an excess of a liquid mixture of alcohol and water in the ratio 3 : 1. Results were:

R	1·100	1·108	1·115
T (sec)	$0·025 \pm 0·02$	$0·30 \pm 0·05$	$0·41 \pm 0·06$
R	1·123	1·130	1·138
T	$0·28 \pm 0·05$	$0·14 \pm 0·04$	$0·05 \pm 0·02$

L. PINCHERLE

537.542

5899. Measurements on the recovery of the Wilson cloud chamber. J. C. KLUYVER AND P. M. ENDT. *Physica*, **16**, 257–68 (*March*, 1950).

The recovery time in an operating ("wet") cloud chamber was measured by the "search-light" method of Milatz and van Heerden. As thus found it is much longer than the value calculated, starting from the assumption that only heat conduction is important in the recovery process. Measurements of the temperature in the "dry" chamber (no vapour present) after compression led to a recovery time agreeing with the calculated value. It is suggested that in the wet chamber the recovery is chiefly governed by the slow supply of vapour from the liquid to the gas, the vapour concentration having been lowered in the expansion period by the formation of droplets.

A.

537.542 : 532.65

Drop formation on ions in the Wilson cloud-chamber. *See Abstr.* 5566

IONIZATION . THERMIONICS 537.56/.58

537.561

5900. Appearance potentials of some metastable transition ions found in hydrocarbon mass spectra. R. E. Fox and A. Langer. *J. Chem. Phys.*, **18**, 460–4 (*April*, 1950).

A comparison shows that in most cases studied, an additional energy of about 2 eV is required for the formation of the metastable state. However, in the case of normal butane, two transitions were studied in which no additional energy was required within an experimental error of 0·3 eV. Evidence is presented which indicates that in some cases the appearance potentials of ions in hydrocarbon spectra are affected by these metastable ion contributions. This effect may account for some of the unexplained discrepancies found in published data on hydrocarbon gases. A.

537.562 : 539.164

5901. The ionization in argon and in air by single alpha-particles as a function of their energy. W. P. Jesse, H. Forstat and J. Sadauskis. *Phys. Rev.*, **77**, 782–6 (*March* 15, 1950).

An extended series of measurements has been made to determine the possible variation of W, the energy to make an ion pair in pure A, with the energy of the ionizing α-particle. The ionization in A relative to the ionization produced by a comparison Po α has been measured for the α-emitters ThX, ThC, ThA, RaC′, ThC′. For α-particles in this energy region from 5 to 9 MeV, no deviation of W from the average W for the Po α could be found amounting to as much as ½%. This is in marked contrast to the α-ionization in air from the work of Stetter [*Z. Phys.*, **120**, 639 (1943)]. More indirect measurements in the region 1–5 MeV indicate no measurable change in W for α-particles in A, while values derived from the Stetter curve for air show a marked increase of W as zero α-energy is approached. Evidence from direct measurements is given to show that the energy to make an ion pair in A for the Li^{7*} ion emitted from the reaction $B^{10}(n, \alpha)Li^{7*}$ is apparently the same as the average for the Po α-particle. A.

537.563 : 537.525

5902. He_2^+ in the helium discharge. R. L. F. Boyd. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 543–4 (*May*, 1950).

Values of the ratio He_2^+/He^+ between 2 and 5 were found with the spectrometer probe [Abstr. 3171 (1950)] in a hot-cathode He discharge at various pressures and currents.

537.563/.564

5903. Ionization of negative oxygen ion by electron impact. I. M. Watanabe. *J. Phys. Soc. Japan*, **4**, 203–7 (*July–Dec.*, 1949).

It is suggested that ionization (and also recombination) of negative ions can result from interaction with free electrons, and the cross-section for such a process is calculated using group theory; application to ionosphere is suggested. F. Llewellyn Jones

537.563/.564 : 551.510.535

5904. Ionization of negative oxygen ion by electron impact. II. M. Watanabe. *J. Phys. Soc. Japan*, **4**, 208–12 (*July–Dec.*, 1949).

Numerical values of ionization function for O^- are calculated from formula for cross-section deduced in previous abstract: ionization begins at 3·0 eV, and the function is double-humped. It is concluded that in the ionosphere the O^- ion is stable at night when solar radiation is absent, but that if electrons come from the sun and elsewhere with mean energies $> 0{\cdot}1$ eV considerable ionization can occur.

F. Llewellyn Jones

537.566 : 536.46

5905. Studies on the ionization produced by metallic salts in flames. I. The determination of the collision frequency of electrons in coal-gas/air flames. H. Belcher and T. M. Sugden. *Proc. Roy. Soc., A*, **201**, 480–8 (*May* 23, 1950).

As an introduction to the study of reactions contingent on ionization in flames, an experimental measurement has been made of the collision frequency of electrons with molecules in coal-gas/air flames, containing added alkali metal salt. This quantity is an important parameter in the expression relating the electron content of a flame with the attenuation of centimetric radio waves by it. This attenuation has been chosen as a convenient method of investigating flame ionization. The form of the results obtained agree well with the predictions of theory, a uniform difference of about 20% between measured collision frequency and that calculated on a very simple gas kinetic hypothesis being obtained. A suitable conversion factor has been evolved for proceeding from attenuation of 3 cm waves to electron concentration/cm³. A.

537.58 : 621.385.2

5906. On the retarding field current in diodes. R. Fürth and D. K. C. MacDonald. *Proc. Phys. Soc., Lond. B*, **63**, 300–2 (*April*, 1950).

Statistical methods are used to derive expressions for the limiting current above which a space charge minimum exists. Cylindrical and planar diodes are discussed. The results agree with those of Schottky (1914) except for trivial numerical factors and recent conclusions by Bell [Abstr. 4029 (1949)] are criticized. It is pointed out that the best way of using the retarding field characteristic for temperature measurement is to plot $I_a r_a$ against I_a. If $I_a > I_c$, the critical value, the apparent temperature is too high.

A. H. W. Beck

537.581

5907. Preparation of rhenium emitters and measurements of their thermionic properties. R. Levi and G. A. Espersen. *Phys. Rev.*, **78**, 231–4 (*May* 1, 1950).

A method is described for electroplating stable Re on a W wire. The thermionic emission properties of Re were investigated and values of the work function, $\phi = 4{\cdot}74$ eV and of the emissivity $A = 720$ A/cm²/deg.² were obtained. An increase of temperature produces no change of activation in a Re cathode. Emission results were reproducible. A.

537.581

5908. On the thermionic constants of a polycrystalline metal. II. T. Arizumi. *J. Phys. Soc. Japan*, **3**, 186–90 (*July–Aug.*, 1948).

Pt I [Abstr. 4058 (1949)] developed the expressions

for the thermionic constants of a polycrystalline material derived from the Richardson plot. This paper considers the contact p.d. method of work function determination. When the emission is due mainly to the area with lowest work function the two methods give different results, but when the area of high work function is dominant they agree. The results are used to analyse experimental data on polycrystalline W, for which the variation in ϕ is known. A certain agreement is obtained but only one value for the retarding field ϕ is given.

A. H. W. BECK

537.581

5909. Average thermionic constants of polycrystalline tungsten wires. M. H. NICHOLS. *Phys. Rev.*, **78**, 158–61 (*April* 15, 1950).

Because of its property of producing large crystals, the "doped" variety of W wire is used in the study of the thermionic properties of single crystal surfaces of W. In order to determine the effect of the impurities added to produce this property, the average high field thermionic constants of polycrystalline doped W wire and undoped W wire were measured. The thermionic constants from the doped wire are somewhat lower than those from the undoped wire which agree well with previously published values. Chemical and spectroscopic analyses before and after heat treatment are included. It is concluded that the differences in thermionic properties between the two types of wire are probably due to different distributions of the types of crystal surfaces exposed. A.

537.583

5910. Thermionic constants of the oxide-coated cathode. T. ARIZUMI. *J. Phys. Soc. Japan*, **3**, 191–8 (*July–Aug.*, 1948).

The theory developed in the above is applied to the oxide cathode, with the assumption that two work functions with a difference of $\simeq 0{\cdot}8$ eV exist. It is concluded that the emission is given by the expression $i = AT^2\,[p \exp(-\phi_1/kT) + (1-p)\exp(-\phi_2/kT)]$, where p = relative area covered by material of $\phi_1 (< \phi_2)$. Observations on change of emission during activation can be explained if p changes from 10^{-7} to 10^{-3}. A. H. W. BECK

537.583

5911. On the active centers of the oxide-coated cathode. H. KAWAMURO, A. SHINOHARA AND K. TAKAHASHI. *J. Phys. Soc. Japan*, **3**, 301–4 (*Sept.–Dec.*, 1948).

Measured amounts of Ba were evaporated on to the cathode from a batalum getter, the quantity being estimated by the increase in activity of a W wire placed at the same distance from the source as the cathode. If i_1 = emission before evaporation, i_2 = emission after evaporation, semiconductor theory indicates that $i_2^2 - i_1^2 \propto$ quantity of evaporated Ba. This relation was found to be correct and the optimum activation was at $\simeq 10^{16}$ impurity atoms/cc. The heat evaporation of Ba was deduced by the deactivation at high temperatures, the activation energy for this process being $\simeq 2{\cdot}3$ eV. A. H. W. BECK

537.583

5912. On the effect of oxygen upon the oxide-coated cathode. T. ARIZUMI AND S. NARITA. *J. Phys. Soc. Japan*, **3**, 356–60 (*Sept.–Dec.*, 1948).

The cathode was poisoned with O_2 at constant pressure until an equilibrium state was obtained. Curves were obtained for several values of T. Plots of $\ln i \sim \ln p$ consisted of two straight lines, with larger slope for $p > 10^{-4}$ mm Hg. The corresponding Richardson lines were plotted; these were curved at high pressures. A comparison with theoretical expectations is made. A. H. W. BECK

537.583 : 537.533.7 : 621.385.1.032.216

5913. The influence of gases and vapours on emission from oxide cathodes. G. HERRMANN AND O. KRIEG. *Ann. Phys., Lpz.* (*Folge* 6) **4**, 441–64 (1949) *In German.*

The effect of He, A, Kr, H_2, O_2, CO and CO_2 and various hydrocarbons on well activated oxide cathodes was studied. The rate of fall of emission was measured as a function of gas pressure and sleeve temperature. The noble gases and H only influence the emission by lowering the temperation by conduction. Ion bombardment in these gases only reduced the emission when the coating had been nearly completely removed. O_2 poisoned the cathode while CO and CO_2 reacted at low temperatures, the suggested reactions being: $Ba + CO_2 \rightleftharpoons BaO + CO$; $MeO + CO_2 \rightleftharpoons MeCO_3$, where Me is used for either Ba or Sr; $Ba + CO \rightleftharpoons BaO + C$; $MeO + 2CO \rightleftharpoons MeCO_3 + C$. CO produces much less poisoning than CO_2, which in turn produces less than O_2. Among the hydrocarbons CH_4 is particularly interesting as it produces relatively little effect unless it is ionized, when a marked poisoning is produced. This is due to the increased rate of formation of C. Pressure-temperature diagrams for constant ϕ are given and the importance of the technique for catalysis and reaction studies stressed.

A. H. W. BECK

COSMIC RAYS 537.591

537.591

5914. Components of cosmic radiation and their intensity in the atmosphere. K.-H. HÖCKER. *Ann. Phys., Lpz.*, **6**, 353–64 (1949) *In German.*

Discusses the spectrum of primary particles and the interrelation of the intensity of the various components of cosmic rays as a function of depth in the atmosphere. J. G. WILSON

537.591.1

5915. Mass of cosmic ray particles. E. BASTIN, J. BECKER, P. CHANSON, E. NAGEOTTE AND P. TREILLE. *C.R. Acad. Sci., Paris*, **230**, 739–41 (*Feb.* 20, 1950) *In French.*

The range of particles at 3 650 m of which the momentum is measured in a cloud chamber is determined using a succession of Cu screens separating efficient counter layers. No evidence is obtained of particles intermediate in mass between mesons and protons: if present these must either be of very short life ($< 10^{-9}$ sec) or of intensity $< 5 \cdot 10^{-5}$ cm^{-2} sec^{-1} sterad^{-1}. Particles apparently of mass equal to or greater than that of the proton appear to be more numerous than expected. J. G. WILSON

537.591.1

5916. Mass of cosmic ray particles observed at 1 000 m altitude. C. PEYROU, A. LAGARRIGUE AND F. BOUSSER. *C.R. Acad. Sci., Paris*, **230**, 1058–60 (*March* 13, 1950) *In French.*

Particles for which momentum is measured in a cloud chamber are selected which (1) are produced in an initial filter of various thicknesses Pb, (2) are stopped in successive layers of 1·5 cm Pb below the chamber. The μ-meson mass is measured as $212 \pm 5\ m_0$; π-mesons are not observed nor is a τ-meson identified. The proton intensity in the range interval 27–43 g cm^{-2} Pb, which is 30% with no initial filter, is rapidly reduced in a Pb filter.

J. G. WILSON

537.591.1 : 539.172

5917. Nuclear disintegration stars in photographic emulsions. L. MALASPINA, M. MERLIN, O. PIERUCCI AND A. ROSTAGNI. *Nuovo Cim.*, **7**, 145–53 (*March*, 1950) *In Italian.*

Ilford C2 nuclear plates were exposed at 4 550 m under various thicknesses of Pb and Al. 3-prong stars showed a marked transition effect both between air and Pb, and between air and Al. The same effect was observed in plates placed above the absorbers, and explained as being due to evaporation neutrons. The mean free path of the radiation producing 4-prong stars was found to be 320 g/cm^2 in Pb and 90 g/cm^2 in Al.

L. PINCHERLE

537.591.15

5918. On the nature of cosmic ray bursts. Y. FUJIMOTO AND S. HAYAKAWA. *Progr. Theor. Phys.*, **4**, 502–13 (*Oct.–Dec.*, 1949).

The term "bursts" includes differing phenomena which give rise to momentary heavy ionization in an ionization chamber. A quantitative treatment of the variation and relative importance of (for unshielded chambers) nuclear disruptions and extensive air showers, and (for shielded chambers) knock-on showers and nucleon induced showers is given.

J. G. WILSON

537.591.15

5919. Neutron component in extensive air showers. Y. FUJIMOTO, S. HAYAKAWA AND Y. YAMAGUCHI. Letter in *Progr. Theor. Phys.*, **4**, 579 (*Oct.–Dec.*, 1949).

The contribution of a (γ, n) reaction with resonance at energies of the order 20 MeV to the neutron component in extensive air showers is estimated.

J. G. WILSON

537.591.15

5920. High energy electronic component in extensive air showers. Y. FUJIMOTO AND S. HAYAKAWA. Letter in *Progr. Theor Phys.*, **4**, 579–81 (*Oct.–Dec.*, 1949).

The experimental decoherence curve for extensive showers (data for Echo Lake) is considered to be inconsistent with the descent of the showers from single primary electrons.

J. G. WILSON

537.591.15

5921. Existence in air of the penetrating particles of extensive showers. R. MAZE. *C.R. Acad. Sci., Paris*, **230**, 742–3 (*Feb.* 20, 1950) *In French.*

Three counters, closely placed with axes parallel and with one pair in a vertical plane, a second in a horizontal plane, heavily shielded bottom and sides and under a top shield variable to 22·5 cm Pb, are operated in coincidence with an extensive-shower selector at a distance of 10 m. Twofold coincidences, vertical and horizontal and threefold coincidences are recorded. The results support the view that the majority of penetrating particles pre-exist in the shower in air and partake of its general direction.

J. G. WILSON

537.591.15

5922. Extensive showers penetrating, soft particles, and photons; barometric influence. J. CLAY. *Physica*, **16**, 278–92 (*March*, 1950).

The proportion of penetrating to soft particles which is found in showers depends on the dimensions and distance of the counters. The influence of Pb layers above and between the counter sets is measured, from which the amount of photons in the showers can be calculated. The increase by the production of the photons enlarges the number of coincidence possibilities. In the relation of frequency to density $I(F) = I_0 \int_0^\infty N^{-s}(1 - e^{-FN})^n dN$ we find that S decreases with N. For $N = 9(\mathrm{m}^{-2})$, $S = 3{\cdot}0$ in the same order of magnitude as for the common spectrum, and for $N = 100$, $S = 1{\cdot}5$ the same as for the very big bursts. The number of photons increases with N. The influence of barometric pressure is 14% cm^{-1} Hg. It is concluded that the showers are produced by protons in the higher atmosphere.

A.

537.591.15

5923. The second maximum in the shower curve for tin (Sn). J. CLAY AND G. KLEIN. *Physica*, **16**, 293–6 (*March*, 1950).

3-fold and 5-fold counter coincidences were recorded under layers of Sn up to 34 cm in thickness. A second maximum at 21 cm is reported, and this is compared with the results of other workers. An explanation in terms of knock-on showers is advanced.

E. P. GEORGE

537.591.15

5924. Penetrating showers at high altitude. M. G. NOOH AND S. R. HADDARA. *Proc. Phys. Soc., Lond. A*, **63**, 606–16 (*June*, 1950).

A study has been made of cloud chamber photographs of penetrating cosmic-ray showers, originating in Pb placed over the cloud chamber and in a Pb plate within the cloud chamber, obtained at altitude 3 572 m in a magnetic field of about 1 000 gauss. The use of well separated successive Pb layers allowed the association of penetrating events to be demonstrated, and there is some evidence of a general reduction of energy involved in events in the lower Pb layers as compared with those in the top layer. Mesons, protons and particles of higher charge were identified in the penetrating showers, and a mean range for non-coulomb scattering of shower particles is given. Evidence is also given of the apparent starting and stopping of charged particles in the Pb plate at the centre of the cloud chamber.

A.

537.591.3

5925. Absorption of flare-type cosmic rays. Y. SEKIDO AND T. YAGI. *J. Phys. Soc. Japan*, **4**, 353–4 (*July–Dec.*, 1949).

Observations of the cosmic-ray disturbance of

June 7, 1942, at Tokyo are reported, including measurements under about 80 cm concrete. The deduced absorption of the particles responsible for the intensity variations is correlated with the geomagnetic effect indicated by the Tokyo observations together with others reported elsewhere.

J. G. WILSON

537.591.3

5926. Atmospheric effects on cosmic radiation, air-mass absorption and meson decay. F. LINDHOLM. *Tellus*, **2**, 63–7 (*Feb.*, 1950).

The percentage variations of 24 hr means of c.r. in Stockholm (magn. lat. 58°) amount to $\pm 5\%$ of the mean value over a quiet period of 2 months' duration. The two atmospheric effects, the mass absorption due to ionization and the meson decay, contribute $\pm 4\%$. The residual variations, in excess of statistical fluctuations of 0·1%, depend upon other factors, such as geomagnetic activity and solar influences. The true absorption coefficient for zenith radiation (β) is calculated to have a value of $1{\cdot}27 \times 10^{-3}$ cm²/g and the rate of decay (β') is found to be about 0·060 pr km. The meson-producing layer is attributed to the 200 mb surface, the highest level reached by the daily radiosonde ascents in Stockholm. The most reliable decay value is obtained by considerations of the thermal structure of air-mass changes in travelling deep depressions. A.

537.591.5

5927. The east-west asymmetry of positive and of negative mesons and the excess of the positives as a function of zenith angle and altitude. G. GROETZINGER AND G. W. MCCLURE. *Phys. Rev.*, **77**, 777–81 (*March* 15, 1950).

The E–W asymmetry of + and − mesons of energies around 800 MeV has been determined at altitudes of 260 and 4 300 m at a geomagnetic latitude of 50° N for zenith angles of 24 and 58 degrees. It is found that more + mesons arrive from the W than from the E and more − mesons arrive from the E than from the W, the asymmetries being equal but of opposite sign. From the magnitude of the asymmetries it can be concluded that the majority of the mesons observed under the above-mentioned conditions are produced in the top layer of the atmosphere. An increase of the positive excess for mesons of around 800 MeV is observed with an increase of the altitude from 260 to 4 300 m. A.

537.591.5

5928. Directional distribution of extensive air showers. Y. FUJIMOTO, S. HAYAKAWA AND Y. YAMAGUCHI. Letter in *Progr. Theor. Phys.*, **4**, 571 (*Oct.–Dec.*, 1949).

The zenith angle variation for extensive air showers is calculated on the basis of nuclear primaries for depth 20 cascade units, and the result at this depth is shown to agree well with measurements by Brown and McKay. J. G. WILSON

551.591.5

5929. Soft component in upper atmosphere. S. HAYAKAWA AND J. NISHIMURA. Letter in *Progr. Theor. Phys.*, **4**, 578–9 (*Oct.–Dec.*, 1949).

The intensity-depth relation of the soft component in the high atmosphere is shown to be well given by the combined decay contributions of μ- and π- mesons. J. G. WILSO

537.591

5930. The effect of the equatorial ring current o cosmic ray intensity. S. HAYAKAWA, J. NISHIMURA T. NAGATA AND M. SUGIURA. *J. Sci. Res. Inst Tokyo*, **44**, 121–6 (*Feb.–March*, 1950).

From Störmer's theory, the change in intensit following the establishment of equatorial curren circulating outside the earth's surface is evaluate When the current strength is adjusted to correspon with the change in magnetic field associated wit storms, the resulting change in cosmic-ray intensit is much smaller than that observed. E. P. GEORG

537.591

5931. Observations of the E–W asymmetry b means of single tracks in emulsion. M. MORAN L. WINAND AND C. BEETS. *Bull. Soc. Roy. Sc Liège*, **18**, 134–6 (*April–May*, 1949) *In French.*

Ilford C2 and G5 (electron sensitive) emulsion have been exposed at 1 600 m 2° S, and 2 300 m 22° N For single heavy tracks strong asymmetry is observe while for collimated showers of minimum ionizatio tracks there is no asymmetry. The results permit th asymmetry to be given as a function of zenith angl for the two stations. It is concluded that while th majority of mesons and electrons arise from non field-sensitive primaries, the primaries of a larg fraction of isolated heavy tracks are of low enoug energy to be field sensitive. J. G. WILSO

537.591.

5932. Stars and single tracks produced by cosmi rays in photographic emulsions. C. BEETS, M. MORAN AND L. WINAND. *Bull. Soc. Roy. Sci. Liège*, **18**, 481– (*Dec.*, 1949) *In French.*

Ilford G5 and C3 + B emulsions were exposed a 4 500 m in latitude 1° S (geomag.). The size distri bution of stars and the intensity of the star-producin radiation (estimated reduced by a factor 2·1 com pared with 44° N geomag. at same altitude) ar discussed. The lightly ionizing tracks of stars wit more than 9 prongs are shown to have a strong excess, while isolated slow tracks show an E–W asymmetry with a strong E maximum at 60° zenit angle. J. G. WILSO

537.591.

5933. Cloud-chamber study of cosmic rays under ground. O. L. TIFFANY AND W. E. HAZEN. Letter i *Phys. Rev.*, **77**, 849 (*March* 15, 1950).

A cloud chamber with four 2·5 cm Pb plates an controlled by counters in the centre of the chambe and below it was operated at 860 m w.e. depth. O 175 photographs, 153 showed normal penetratin particles, and not more than 3% could have bee caused by non-ionizing penetrating particles. Th range and number of secondary electrons from th roof of the mine was consistent with the postulate high average energy of primary mesons.

J. G. WILSO

537.591.

5934. Cosmic-ray underground. II. S. HAYAKAWA AND S. TOMONAGA. *Progr. Theor. Phys.*, **4**, 496–50 (*Oct.–Dec.*, 1949).

The development of soft component secondary t

μ-mesons by knock-on, radiation and pair production is examined to establish that this source of the soft component is adequate. This conclusion is confirmed as far as experimental data permit. J. G. WILSON

537.591.8

5935. Transition effect of the star-producing radiation. N. DALLAPORTA, M. MERLIN AND G. PUPPI. *Nuovo Cim.*, **7**, 99–108 (*March*, 1950) *In Italian.*

While generally decreasing when the thickness of the absorber increases, the number of small stars produced by cosmic rays in a photographic plate shows a slight transition effect. A tentative theory is suggested in which the effect is attributed to secondary neutrons produced by evaporation processes in the absorbing block surrounding the plates. The correct order of magnitude of the effect is obtained. L. PINCHERLE

537.591.8

5936. The energy spectrum from a simple cosmic induction accelerator. G. P. DISHKANT. *J. Exp. Theor. Phys., USSR*, **20**, 206–10 (*March*, 1950) *In Russian.*

The acceleration is considered in the electromagnetic field of rotating stars whose magnetic and rotation axes coincide. The charge of the stars is calculated. The upper energy limit attainable, E_m, appears to be $\sim 10^{13}$ eV. The calculated energy-spectrum is a complicated function of energy, somewhat different from that observed, and has a pole at E_m. E. P. GEORGE

537.591.8

5937. The production of nuclear disintegrations and neutrons at the geomagnetic equator. J. A. SIMPSON, JR. AND E. HUNGERFORD. Letter in *Phys. Rev.*, **77**, 847–8 (*March* 15, 1950).

537.591.8 : 539.18

5938. The positive excess of mesons. M. CINI AND G. WATAGHIN. *Nuovo Cim.*, **7**, 135–44 (*March*, 1950) *In Italian.*

Multiple production of mesons is assumed. The momentum spectrum of the created mesons is suitably cut off at large energies. Average energy losses are taken from experimental data. The symmetrical theory of nuclear forces is applied. The positive excess of μ-mesons at sea level calculated under the above hypotheses is in satisfactory agreement with experiment in the energy region between 1 and 15 $\times 10^9$ eV. L. PINCHERLE

537.591.8 : 539.18

5939. Positive excess and multiple production of mesons. P. CALDIROLA AND A. LOINGER. Letter in *Nuovo Cim.*, **7**, 161–5 (*March*, 1950) *In Italian.*

The theory previously developed [see Abstr. 3250 (1950)] is extended to include multiple processes of meson production. Recent experimental results on the positive excess at sea level would appear to indicate that in the impact between two nucleons only single mesons are produced up to energies ~ 2–4×10^{10} eV; but the emission of two mesons becomes more important and indeed the most probable process for energies between the above value and 10^{11}, while higher multiplicity processes prevail above 10^{11} eV. L. PINCHERLE

537.591.8 : 539.18

5940. Nuclear cross-sections of high energy pi-mesons. K. GREISEN. Letter in *Phys. Rev.*, **77**, 713–14 (*March* 1, 1950).

The result of Piccioni [Abstr. 3234 (1950)] that the nuclear cross-section for π-mesons is small, is criticized: (1) because the observation that the mass absorbing powers of Pb and Fe are about equal is to be expected for the last 80 gm/cm^2 of absorption even when nuclear interaction is strong; (2) because the number of π-mesons stopped and recorded may be increased by nuclear interactions which lead to slow π-mesons in place of energetic π-mesons; (3) because the smaller difference between absorption mean free path and collision m.f.p. in air as compared with condensed materials is most easily explained if π-mesons, which in air are removed by decay, are effective secondary nuclear interactors in condensed matter. J. G. WILSON

MAGNETISM 538

538.082

5941. A radiofrequency spectrograph and simple magnetic-field meter. R. V. POUND AND W. D. KNIGHT. *Rev. Sci. Instrum.*, **21**, 219–25 (*March*, 1950).

A simple oscillating circuit with a special feedback circuit is employed as a tool for the search for and detailed analysis of nuclear paramagnetic absorption lines. The sensitivity approaches the optimum for a given noise band width and particularly useful is the ease of conducting slow, continuous changes of frequency while recording the output data. Spectra having several components at scattered frequencies are thus displayed. Line shapes are unambiguously recorded because of the absence of sensitivity to dispersion. Using protons in water, or solutions containing Li^7, the device can be used as a versatile and extremely precise meter for measuring magnetic field strengths in the range from about 100 to 25 000 oersteds with a minimum of auxiliary equipment. A.

538.1

5942. On the definition of magnetic moment. W. DÖRING. *Ann. Phys., Lpz.*, **6**, 69–88 (1949) *In German.*

When the magnetic moment M of a magnetized body is defined as: torque $= M \times H$, and the magnetization I through the equation: $B = \mu_0 H + I$, then M is equal to the volume integral of the magnetization of the body itself and of surrounding bodies that have been magnetized by induction. If M is defined instead by: torque $= M \times B$, there is no corresponding relation between M and I. The author concludes that for this reason, and also on the grounds of an analogy with electrostatics, one should consider H and not B as the magnetic force vector. L. PINCHERLE

538.1 : 538.221

5943. Introduction of the idea of "intermittent activation" in the electronic state of ferromagnetics. R. FORRER. *C.R. Acad. Sci., Paris*, **230**, 1254–5 (*March* 27, 1950) *In French.*

A summary of the basic idea is given (that the

interaction between the various groups of electrons takes place intermittently). Various parameters are given for Fe and Ni. The absence of ferromagnetism in Mn and Cr, contrasted to its presence in their alloys, is interpreted. E. P. WOHLFARTH

538.114

5944. On the discrete-continuous spectrum of induction of a ferromagnetic for cyclic magnetization. A. A. GRACHEV. *Dokl. Akad. Nauk, SSSR*, **71** (*No.* 2) 269–71 (1950) *In Russian.*

If the jumps of magnetization (Barkhausen effect) in a hysteresis cycle occur entirely reproducibly, the e.m.f. in a coil round a specimen which is magnetized by an alternating field should have only a line spectrum. If the jumps are not strictly reproducible there should also be a continuous spectrum, since B is then no longer a strictly periodic function of time. Experiments on unannealed permalloy and other ferromagnetics showed that for a fundamental frequency of 3 kc/s, the induced e.m.f. consisted of a continuous spectrum from 4 to 50 kc/s in addition to the line spectrum (i.e. the harmonics).

D. SHOENBERG

538.114

5945. Grain boundary slip and magnetic relaxation at high temperatures in iron. J. L. SNOEK. Letter in *Physica*, **16**, 336 (*March*, 1950).

538.114 : 538.653

5946. The influence of pressure on the Curie point. A. MICHELS AND S. R. DE GROOT. *Physica*, **16**, 249–52 (*March*, 1950).

A critical study is given of a publication of Ebert and Kussmann on the pressure effect on the magnetization of some alloys. It is shown that the accuracy of these results does not permit the conclusions they have drawn from their experiments. A.

538.114 : 548.0

5947. Ferromagnetic compounds of manganese with perovskite structure. G. H. JONKER AND J. H. VAN SANTEN. *Physica*, **16**, 337–49 (*March*, 1950).

Various manganites of the general formula $La^{3+}Mn^{3+}O_3^{2-}$–$Me^{2+}Mn^{4+}O_3^{2-}$ have been prepared in the form of polycrystalline products. Perovskite structures were found, i.a. for all mixed crystals $LaMnO_3 - CaMnO_3$, for $LaMnO_3 - SrMnO_3$ containing up to 70% $SrMnO_3$, and for $LaMnO_3 - BaMnO_3$ containing less than 50% $BaMnO_3$. The mixed crystals with perovskite structure are ferromagnetic. Curves for the Curie temperature *v.* composition and saturation *v.* composition are given for $LaMnO_3 - CaMnO_3$, $LaMnO_3 - SrMnO_3$ and $LaMnO_3 - BaMnO_3$. Both types of curves show maxima between 25 and 40% $Me^{2+}Mn^{4+}O_3^{2-}$; here all 3*d* electrons available contribute with their spins to the saturation magnetization. The ferromagnetic properties can be understood as the result of a strong positive $Mn^{3+} - Mn^{4+}$ exchange interaction combined with a weak $Mn^{3+} - Mn^{3+}$ interaction and a negative $Mn^{4+} - Mn^{4+}$ interaction. The $Mn^{3+} - Mn^{4+}$ interaction, presumably of the indirect exchange type, is thought to be the first clear example of positive exchange interaction in oxidic substances. A.

538.8

5948. Interaction between magnetised spheroids i permeable fluid media. G. W. PRESTON. *Amer. Phys.*, **17**, 136–9 (*March*, 1950).

Formulae are given for the torque on uniform magnetized spheroid in a permeable medium due the field (perp. to axis) of another magnetiz spheroid. The spheroids' magnetizations are paral to their axes. Results for needles, spheres and dis are deduced from general solution [L. Page, *Phy Rev.*, **44**, 112–15 (*July* 15, 1933)]. T. S. E. THOM

538.12 : 537.312.

5949. Conservation of flux by a superconducti torus. R. L. DOLECEK AND J. DE LAUNAY. *Phy Rev.*, **78**, 58–60 (*April* 1, 1950).

A superconducting torus was subjected to magnetic field normal to the plane of the torus an the field distribution across the plane of the supe conducting torus was determined experimentall The magnetic field near the axis of the torus wa found to have the same direction as the applied field but near the inner surface of the torus the fiel reversed direction in such a manner that the tota flux enclosed by the torus was zero. It is conclude that the magnetic field distribution about a super conducting torus in weak magnetic fields can b adequately described by classical electrodynamics an the assumption of perfect diamagnetism. A

538.22 : 536.4

5950. On the magnetic properties of liquid He L. GOLDSTEIN AND M. GOLDSTEIN. *J. Chem. Phys* **18**, 538–44 (*April*, 1950).

Liquid He^3 might have a tendency toward nuclea ferromagnetism in the approximation where this fluid is considered to be an antisymmetrical collection o atoms having an angular momentum of $\hbar/2$ and a finite nuclear magnetic moment. In the rather crud approximation where the motion of the individua atoms is described with the help of plane de Broglie waves, the exchange energy, originating in the inter atomic mutual potential energy of He^3 atoms, favours the parallel alignment of all spins at the temperature of absolute zero. The total energy of the fluid is however, smaller in the antiferromagnetic configura tion because its kinetic energy is smaller than in the ferromagnetic configuration. To the approximation of these studies, then liquid He^3 does not show nuclear ferromagnetism. Its nuclear paramagnetism is then discussed. A.

538.22 : 548.0

5951. The weak ferromagnetism believed to be present in α-Fe_2O_3 and other antiferromagnetic compounds. J. L. SNOEK. *Physica*, **16**, 333–5 (*March*, 1950).

The evidence for a small permanent moment observed below the critical temperature in most antiferromagnetic compounds is traced back to lattice imperfections. A.

538.221

5952. Collective electron ferromagnetism. II. H. WATANABE. *J. Phys. Soc. Japan*, **3**, 317–22 (*Sept.–Dec.*, 1948).

A theory of collective electron ferromagnetism

[see Abstr. 3968 (1949)] is used to calculate susceptibility above the Curie point and the specific heat associated with ferromagnetism. The high-temperature susceptibilities are compared with experimental results for Ni and its alloys. Calculated electronic specific heats for Ni and Co do not agree with the observed values. A. E. De BARR

538.221

5953. Magnetic after-effect in the Rayleigh region. J.-C. BARBIER. *C.R. Acad. Sci., Paris*, **230**, 1040–1 (*March* 13, 1950) *In French.*

Experimental investigations on solid ferromagnetics show that the time decrease of $\sqrt{(I_r)}$, due to previous removal of an applied field, is proportional to the time interval after removal and is independent of the field and of its length of application, in agreement with theoretical results due to Néel [Abstr. 4211 (1950)]. E. P. WOHLFARTH

538.221

5954. Some laws relating to the magnetic after-effect [in weak fields]. L. LLIBOUTRY. *C.R. Acad. Sci., Paris*, **230**, 1042–4 (*March* 13, 1950) *In French.*

The effect was investigated by applying a field h of the same sign as the main applied field H such that h/H remained small. A curve is given showing the variation with h of a quantity s, defined by $\Delta J = \chi h + 2RH(h - s \log t)$, where R is the Rayleigh constant; this quantity has been introduced by Néel [Abstr. 4211 (1950),] whose theoretical results are applied. E. P. WOHLFARTH

538.221

5955. Theory of magnetic properties and nucleation in Alnico V. C. KITTEL, E. A. NESBITT AND W. SHOCKLEY. Letter in *Phys. Rev.*, **77**, 839–40 (*March* 15, 1950).

538.221

5956. Preparation and magnetic properties of Mn and Co ferrites. C. GUILLAUD AND H. CREVEAUX. *C.R. Acad. Sci., Paris*, **230**, 1256–8 (*March* 27, 1950) *In French.*

The ferrites investigated have the general composition $Fe_2O_3 . MO$. Magnetic properties measured include the saturation moment, σ_0, the Curie temperature, θ_f, the temp. variation of σ, and hysteretic and resistive properties. For M = Mn, $\sigma_0 = 110{\cdot}7$, $\theta_f = 568°$K and σ varies as T^2 and 1/H in the limits. For M = Co a low temp. anomaly was observed in the variation of σ with T. A more uncertain extrapolation gives $\sigma_0 = 87{\cdot}5 \pm 0{\cdot}5$, $\theta_f = 788°$ K. The coercivity of the Co ferrite was found to be large and strongly temperature dependent, reaching 1 660 oersted at 77° K. E. P. WOHLFARTH

538.221

5957. Ferromagnetic properties of mixed ferrites for cobalt and zinc, and manganese and zinc. C. GUILLAUD AND H. CREVEAUX. *C.R. Acad. Sci., Paris*, **230**, 1458–60 (*April* 17, 1950) *In French.*

538.221 : 537.312.6

Refinements and new results on the variation with temperature of the electrical resistance of ferromagnetic materials. *See Abstr.* 5843

538.222

5958. The effect of electronic paramagnetism on nuclear magnetic resonance frequencies in metals. C. H. TOWNES, C. HERRING AND W. D. KNIGHT. Letter in *Phys. Rev.*, **77**, 851–2 (*March* 15, 1950).

The difference in the paramagnetic resonance frequency for an atom in the metallic and non-metallic state is ascribed primarily to orientation, by the field, of the spins of the conduction electrons near the Fermi limit and the interaction of these electrons with the nuclei. An expression is derived for the fractional frequency change in terms of a ratio of metallic and atomic wave functions and the spin paramagnetic susceptibility. The ratio of wave functions is estimated for Na, Li and Be. Observed and estimated values of the frequency change are in reasonable agreement. E. P. WOHLFARTH

538.222 : 535.37

5959. Specific magnetic susceptibilities and related properties of manganese-activated zinc fluoride. P. D. JOHNSON AND F. E. WILLIAMS. *J. Chem. Phys.*, **18**, 323–6 (*March*, 1950).

The specific magnetic susceptibilities of Mn-activated ZnF_2 phosphors of diverse activator concentration, and prepared by various crystallization procedures, have been measured from − 60°c to 200°c. A trivial Weiss constant, except for phosphors of inordinately high Mn concentration, demonstrates the absence of appreciable exchange demagnetization of adjacent paramagnetic activator ions and suggests that there exists negligible departure from a random distribution of Mn ions over cation sites. Utilizing this distribution, and recognizing that only Mn ions not having other Mn ions at any of the nearest cation sites are capable of luminescence, an expression for the dependence of luminescent efficiency on activator concentration is derived and found to be in quantitative agreement with experiment. A.

538.222 : 536.48

5960. Some experiments on paramagnetic relaxation at low temperatures. D. BIJL. *Physica*, **16**, 269–77 (*March*, 1950).

Paramagnetic relaxation at audio-frequencies has been studied in manganese ammonium sulphate, manganese sulphate, gadolinium sulphate and copper potassium sulphate. There appears to be a continuous distribution of relaxation constants except in the case of the Mn salts. In all cases second-order absorption and emission processes are still important in the liquid He region. A.

538.23

5961. Coercive force v. temperature in an alloy with zero crystalline magnetic anisotropy. J. K. GALT. Letter in *Phys. Rev.*, **77**, 845–6 (*March* 15, 1950).

Measurements were carried out on Fe–Ni alloy specimens (68% Ni) in a finely divided powdered state (diameters 500–3 000 Å) between − 200°c and + 400°c. For this composition and temperature range the magneto-crystalline anisotropy is zero, and H_c should depend only on the shape and strain anisotropy terms, neither of which are likely to vary appreciably with temperature in the stated range. The observed variation is rather pronounced, however, $H_c/H_c(R.T.)$ vary-

ing between $\sim 1{\cdot}4$ and $0{\cdot}6$ as T/θ_c varies between $0{\cdot}1$ and $0{\cdot}7$. It is suggested as a possible interpretation that the particles may not all be single domains.

E. P. WOHLFARTH

538.245

5962. Saturation magnetization of certain ferrites. L. NÉEL. *C.R. Acad. Sci., Paris,* **230,** 190–2 (*Jan.* 9, 1950) *In French.*

For a spinel of type Fe_2O_3, MO a characteristic temperature, θ, is defined depending on the energy required to interchange M and Fe ions between B and A lattice positions. At absolute zero normal and inverse ferrites correspond to negative and positive values of θ, and it is suggested that in the series M = Mn, Fe, Co, Ni, Cu, Zn, θ decreases continuously with increase of atomic number. Calculated molecular magnetic moments for this series agree well with experimental values, excess moments observed for Co and Ni ferrites being attributable to orbital moment. From measured moments of Cu ferrite after quenching from various temperatures, θ is calculated and found to be approximately the same for each temperature, giving experimental confirmation of the theory of ferrimagnetism.

C. E. WEBB

538.245

5963. Spontaneous magnetization of ferromagnetic ferrites with spinel structure. E. W. GORTER. *C.R. Acad. Sci., Paris,* **230,** 192–4 (*Jan.* 9, 1950) *In French.*

The variation of spontaneous magnetization, M_s, when an increasing percentage of Zn-ferrite is added to the ferrites of Mn, Fe^{II}, Co, Ni, Cu, Mg and $Li_{0{\cdot}5}Fe_{0{\cdot}5}$ is determined. For small additions M_s increases at a rate corresponding to the negative exchange interaction between the A and B sublattices suggested by Néel [see Abstract 3388 (1948)]: for large Zn-ferrite contents a reduction of M_s occurs, consistent with the predominance of the negative BB interaction deduced by Néel from paramagnetic measurements on Cu-ferrite.

C. E. WEBB

538.245 : 539.215 : 548.0

5964. The cation distribution in ferrites with spinel structure. F. G. BROCKMAN. Letter in *Phys. Rev.,* **77,** 841–2 (*March* 15, 1950).

Experiments to determine the effects of quenching on the temperature variation of the initial permeability of Cu–Zn ferrite suggest that quenching from a high temperature brings about a condition equivalent to a reduction of the Zn cation concentration and the replacement of these ions by ferric ions. This conclusion bears out one by Néel [Abstr. 3388 (1948)] that the cation distribution in single and mixed ferrites may not be as ordered as previously supposed.

E. P. WOHLFARTH

538.248

5965. On the decrease of thermo-remanent and isothermal remanent magnetization of baked clays by successive re-heating to increasing temperatures. J. ROQUET. *C.R. Acad. Sci., Paris,* **230,** 282–5 (*Jan.* 16, 1950) *In French.*

In extension of previous observations [see Abstr. 2583 (1950)] curves are given showing the remanent magnetizations, after re-heating to progressively increasing temperatures, as a function of the temperature. For strong magnetizations the curves are similar for isothermal and thermo-remanent magnetizations, indicating that the mechanism of demagnetization is the same in both cases.

C. E. WEBB

ELECTROMAGNETISM . ELECTRODYNAMICS
538.3/.5

538.322 : 530.12 : 621.3.011

5966. Introduction to the electrodynamics of moving conductors. J. BOSQUET. *Mém. Acad. Roy. Belge Cl. Sci.,* **21** (*No.* 4) 5–85 (1948) *In French.*

The electromagnetic laws of induction for open or closed circuits in moving conductors are derived from a new formulation of Ohm's law, based on a detailed examination of the mechanical forces acting on the moving charges, which constitute the current in the conductors. The discussion, which is largely a restatement and development of Lorentz's classical treatment, claims to remove contradictions in classical electromagnetic theory, which arise from confusing electromotive force with electric field-intensity. Lagrange's equations for open and closed linear circuits in motion are derived and applied to technical problems. The energy relations of the electromagnetic field are considered, and the theory of electromagnetic induction developed from the standpoint of general relativity.

A. T. PRICE (R)

538.521

5967. The induction of electric currents in a uniform circular disk. A. A. ASHOUR. *Quart. J. Mech. Appl. Math.,* **3,** 119–28 (*March,* 1950).

538.54

5968. Effect of a periodic magnetic field on a thin metallic spherical shell. A. COLOMBANI. *C.R. Acad. Sci., Paris,* **230,** 1149–50 (*March* 20, 1949) *In French.*

An expression is derived for the heat developed due to eddy currents in terms of the amplitude, H_0, and frequency, ω, of the field, the radius, a, and thickness, e, of the shell and the skin depth, ε, assuming $e \ll \varepsilon$. It is shown that the heat is a maximum for $e = (3/2)(\varepsilon^2/a)$, the maximum value being $(H_0/8)(\omega a^3)$, independent of the specific conductivity.

E. P. WOHLFARTH

538.56 : 621.392

5969. An appreciation of Heaviside's contribution to electromagnetic theory. W. JACKSON. *Instn Elect. Engrs, Paper No.* 949 (1950) 17 *pp.*

A general review covering (*a*) Heaviside's early theoretical work on signalling along wires, performed prior to his study of Maxwell; (*b*) an appreciation of Maxwell's theory and of Heaviside's attitude towards, and contribution to, it; (*c*) a summary of Heaviside's duplex formulation of the electromagnetic field and of his treatment of the flux of energy; (*d*) his analysis of the penetration of magnetic flux into conductors; (*e*) his development of line transmission theory on the basis of Maxwell's theory; (*f*) electromagnetic waves from moving sources; (*g*) Heaviside's views on the rationalization of units; (*h*) his contributions to terminology; and (*j*) his work on many other topics.

A.

538.561

5970. Approximate evaluation of electromagnetic oscillating modes on plate conductor with slowly curved edge. T. SAKURAI. *J. Phys. Soc. Japan*, **3**, 241–5 (*July–Aug.*, 1948).

The equations describing the modes of oscillation are approximated, and analytical solutions are written down. The resonant and the non-resonant cases are treated. L. S. GODDARD

538.566

5971. The wave equation for dispersive media. K. F. HERZFELD. *Ann. Phys., Lpz.* (*Folge* 6) **3**, 69–71 (1948) *In German.*

Under the hypotheses that the magnetic permeability is equal to 1, that the conductivity σ obeys the simple law $j = \sigma E$, and that the medium contains oscillators all with the same frequency ν_0, it is shown that the differential equation for the electric induction D is given in terms of f_e, the effective oscillator strength, b, the friction term, and ε_∞ the high-frequency dielectric constant. If there are different types of oscillators, each new kind increases the order of the equation by 2. The procedure described in this paper cannot be applied in quantum mechanics. L. PINCHERLE

538.566

5972. Energy flow in the vicinity of a diffracting edge. W. BRAUNBEK. *Ann. Phys., Lpz.*, **6**, 53–8 (1949) *In German.*

The field equations for the region which is distant by $\ll$ wavelength from the reflecting plane is easily obtained from the Sommerfeld solution. The special case of normal incidence and electric vector parallel to the edge is considered and the phase surfaces of E and H are calculated. The Poynting vector is then calculated and the result turns out to be the same as the first approximation to the magnetic field, i.e. the stream lines are parabolae with the edge at the focus. A. H. W. BECK

538.566

5973. Graphical solution of wave equations. I. OSIDA. *J. Phys. Soc. Japan*, **3**, 219–22 (*July–Aug.*, 1948).

The method involves the replacement of the various derivatives by appropriate finite-differences. It is explained by an example involving the telegraphic equation. The extension to 2 and 3 dimensions is outlined. L. S. GODDARD

538.566

5974. Graphical study of the dispersion of electromagneto-ionic waves. V. A. BAILEY AND J. A. ROBERTS. *Aust. J. Sci. Res. A*, **53**, 307–21 (*Sept.*, 1949).

A graphical method for approximating to all the 8 roots of the equation of dispersion, corresponding to any numerically specified case, is described. This method uses curves drawn with ω and l as co-ordinates to give readily the following information about the waves which can exist in the medium: (i) the frequency-bands in which undamped waves or wave-groups can grow as they progress, (ii) the wave-number bands in which unattenuated waves can grow in time, (iii) the phase- and group-velocities, refractive indices, and coefficients of positive and negative attenuation and damping, (iv) the general effect of collisions between electrons and other particles on the attenuation or damping of a wave or wave-group. Several illustrative examples are given. The same method is also applied to a special case of the more comprehensive equation of dispersion which includes the effects due to the motions of the positive ions, and it is shown that there can then exist unattenuated waves which grow with the lapse of time. A.

538.566

5975. On the focusing of a wave. J. ORTUSI AND J.-C. SIMON. *C.R. Acad. Sci., Paris*, **230**, 521–3 (*Feb.* 6, 1950) *In French.*

A wave surface, spherical to the 2nd order with centre I, is transformed into a surface, spherical to the 2nd order with centre I'. A focusing occurs when I or I' is at infinity. Various properties of focusing systems are considered; in particular focusing by a circular hole in an infinite reflecting plate. Some experiments with electromagnetic waves of wavelength 8 cm are briefly reported. L. S. GODDARD

538.566 : 534.232

Field of a point source of radiation in a stratified inhomogeneous medium. I–III. *See Abstr.* 5627–9

538.566 : 535.137

5976. The edge condition in the theory of the bending of electromagnetic waves by perfectly conducting plane screens. J. MEIXNER. *Ann. Phys., Lpz.*, **6**, 2–9 (1949) *In German.*

It is possible to construct more than one solution for a particular problem by allowing field intensities to have infinities of different orders at the edge. The problem is uniquely determined by the additional condition that the field energy shall be integrable in the neighbourhood of the edge. R. A. NEWING

538.566 : 535.42

5977. On the diffraction of electromagnetic waves by screens and holes in perfect conductors. I. T. AOKI. *J. Phys. Soc. Japan*, **4**, 183–5 (*July–Dec.*, 1949).

Babinet's principle and various modifications of it are discussed. L. S. GODDARD

538.566 : 535.42

5978. On the diffraction of electromagnetic waves by screens and holes of perfect conductors. II. Approximate formulas and their applications. T. AOKI. *J. Phys. Soc. Japan*, **4**, 185–91 (*July–Dec.*, 1949).

The previous paper [Abstr. 5977 (1950)] is continued. Formulae for the diffracted field are given in the case of circular and elliptical holes. Spherical and plane waves are considered. L. S. GODDARD

538.566 : 535.421

5979. On the diffraction of electromagnetic waves by a wire grating. R. HONERJÄGER. *Ann. Phys., Lpz.* (*Folge* 6) **4** (*No.* 1–2) 25–45 (1948) *In German.*

The grating consists of a number of equal, coplanar, cylindrical and parallel wires, of any cross-section. The electric and magnetic behaviour of the wires are determined by the dielectric constant and the permeability of the material. A plane electromagnetic wave is incident on the grating at any angle, and is partly transmitted and diffracted by the grating. An expression is found for the transmission coefficient, D, and for the intensity of the diffracted wave. The mathematics involved includes the summation of certain series involving Bessel functions. A number

of graphs show the variation of the real and imaginary parts of D with various parameters. An experimental method for verifying the theory is described and some curves are drawn comparing the measured and calculated values of D. L. S. GODDARD

538.566 : 621.396.671

5980. The reflection of spherical waves. H. OTT. *Ann. Phys., Lpz.* (*Folge* 6) **4** (*No.* 8) 432–40 (1949) *In German.*

Previous calculations [see Abstr. 622 (1943)] referring to waves radiated by a vertical dipole are extended to the case when the axis of the dipole is at any angle to the normal to the reflecting plane surface. L. PINCHERLE

538.566 : 621.396.9 : 551.578.1

5981. The scattering of ten-centimetre radio waves by rain. R. C. LANGILLE. *J. Geophys. Res.*, **55**, 51–2 (*March*, 1950).

Reflections of 10 cm waves by rain have been used to obtain distributions of free rain-water by employing a modified height-finding radar equipment. A.

538.566.3 : 523.72

5982. Transients in an ionized medium with applications to bursts of solar noise. J. C. JAEGER AND K. C. WESTFOLD. *Aust. J. Sci. Res. A*, **53**, 322–34 (*Sept.*, 1949).

Exact solutions of a number of transient problems on linear propagation in a homogeneous ionized medium without magnetic field are given. The Fourier transforms of the solutions are discussed and their importance in this type of work emphasized. The effect of inhomogeneity of the medium is studied, and it is shown that if a localized disturbance takes place in the solar atmosphere at a level at which the collision frequency is ν and the frequency of plasma oscillations is ω_0, radiation will be emitted on all frequencies greater than ω_0 with intensity determined by the nature of the disturbance and with damping determined by ν. There is a small difference between the times of arrival on different frequencies, and on each frequency there is a direct wave and an echo wave which arrives some seconds later. Many of the phenomena of bursts of solar noise are consistent with these predictions. A.

538.566.3 : 551.594.6

Longitudinal and transverse propagation in Canada. *See Abstr.* 6189

538.566.3 : 621.396.11

5983. A note on ionospheric radio wave polarization. A. L. ADEN, J. T. DEBETTENCOURT AND A. T. WATERMAN, JR. *J. Geophy. Res.*, **55**, 53–6 (*March*, 1950).

The notion that the ordinary and extraordinary ellipses should have mutually perpendicular major axes is not, in general, correct, being applicable only in the case in which the collisional friction of the electrons is neglected. The paper clarifies this point. A.

MAGNETIC EFFECTS 538.6

538.652

5984. Dilatometric apparatus for the measurement of volume- and linear-magnetostriction. R. VAUTIER. *J. Rech. Cent. Nat. Rech. Sci.* (*No.* 10) 23–7 (1950) *French.*

A detailed description of apparatus with speci reference to elimination of the effects of therma dilatation and to the system of optical magnificatio Results are given of measurements of linear magnetc striction on Ni–Zn and Mg–Zn ferrites showing i each case the existence of a composition for whic the magnetostriction is zero. C. E. WEB

THEORY OF SOLID STATE 539.11

539.1

5985. The surface tension of solids. R. SHUTTLE WORTH. *Proc. Phys. Soc., Lond. A*, **63**, 444–57 (*Ma* 1950).

A distinction is made between the surface Helm holtz free energy F, and the surface tension γ. Fo a crystal face, they are related by $\gamma = F + A(dF/dA$ (A = area of the surface). For a one-componen liquid, $F = \gamma$, but not for crystals. The standar thermodynamic formulae of surface physics ar reviewed, and it is found that the surface free energy appears in the expression for the equilibrium contac angle, and in the Kelvin expression for the excess vapour pressure of small drops, but that the surface tension appears in the expression for the difference in pressure between the two sides of a curved surface. The surface tensions of inert-gas and alkali-halide crystals are calculated from expressions for thei surface energies and are found to be negative. The surface tensions of homopolar crystals are zero if it is possible to neglect the interaction between atoms that are not nearest neighbours. A.

MOLECULAR STRUCTURE 539.13

539.13

5986. The intrinsic viscosity, translational and rotatory diffusion constants of rod-like macromolecules in solution. J. RISEMAN AND J. G. KIRKWOOD. *J. Chem. Phys.*, **18**, 512–16 (*April*, 1950).

539.13 : 541.57 : 535.347–15

Near infra-red pleochroism. I. The perturbed O–H and the C–H modes in polyvinyl alcohol. *See Abstr.* 5713

539.132

5987. On the determination of reciprocal matrices of the potential energy of many-atomic molecules. (Method of determinants.) P. G. MASLOV. *Dokl. Akad. Nauk, SSSR*, **67** (*No.* 5) 819–22 (1949) *In Russian.*

In describing normal vibrations of molecules the potential energy (p.e.) is usually represented by a quadratic function of generalized co-ordinates x_i as $\overline{U} = \frac{1}{2}\sum_{ij} k_{ij}x_i x_j$, where k_{ij} are the dynamic coeffs. forming the p.e. matrix $U = ||k_{ij}||$. As these coeffs.

re not invariant under a transformation of co-ordinates the p.e. is better represented by a function of the generalized forces Q_i as $U = \frac{1}{2}\sum_{ij} k^*_{ij} Q_i Q_j$, with reciprocal matrix $G = ||k^*_{ij}||$. The coeffs. k^*_{ij} are invariant under a co-ordinate transformation, and are called "interaction" coeffs. Indications of evaluating the k^*_{ij} are given according as the off-diagonal elements are large or small. J. JACOBS

539.132

5988. On the determination of reciprocal matrices of the potential energy of many-atomic molecules. Approximate methods of finding the interaction coeffs.) P. G. MASLOV. *Dokl. Akad. Nauk, SSSR*, **70** (*No.* 6) 998–9 (1950) *In Russian.*

Methods are proposed for calculating the interaction coeffs. in the case that all can be represented as functions of anyone of the diagonal coeffs. Simple related molecules must be chosen for which the total number of observed normal frequencies greatly exceeds the number of the required interaction coeffs. This assumes that in passing from one molecule to a related second one the coeffs. either remain unaltered or change according to a well defined law. 3 cases are examined: (i) amongst the Lagrangian simultaneous equations at least 1 is linear; (ii) no linear equations occur but the interactions are small; (iii) the interaction of the generalized equivalent co-ordinates—forces—is large. For methane and deuteromethanes these calculations agree with those of more laborious methods.

J. JACOBS

539.132

5989. On electric vibration-cycle models for the π-electron systems of unsaturated and aromatic hydrocarbons. H. HARTMANN AND W. STÜRMER. *Z. Naturforsch.*, **5a**, 99–100 (*Feb.*, 1950) *In German.*

The problem of determining the energies of π-electrons of hydrocarbons leads to certain secular equations if the method of molecular eigenfunctions is applied. Electric models are discussed for which the secular equations are formally identical with the above. Thus quantum mechanical problems are replaced by measurements of the eigen frequencies of such models. J. JACOBS

539.132

5990. The interchange of translational and vibrational energy in an asymmetric molecular potential field. G. W. CASTELLAN AND H. M. HULBURT. *J. Chem. Phys.*, **18**, 312–22 (*March*, 1950).

Reflection coefficients are calculated for a matter wave in a parabolic channel and in a square channel, each channel closed at one end by a vertical plane tilted slightly from the normal to the axis of the channel. The number of collisions necessary to dissipate one quantum of vibrational energy is given in terms of $\lambda = \tan\theta$, where θ is the angular deviation of the plane end from the normal to the axis of the channel. Comparison with the data from measurements on sound dispersion shows good agreement for N_2O and CO_2. The temperature dependence of the average probability of transition per collision is compared with data for Cl_2 and a mixture of Cl_2 and CO. A.

539.132

5991. On the mean amplitudes of thermal vibrations in CO_2 molecule. Y. MORINO. Letter in *J. Chem. Phys.*, **18**, 395 (*March*, 1950).

539.132

5992. Singlet system B of ZrO. M. AFAF. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 674–5 (*June*, 1950).

539.132 : 535.343–14

5993. On the ammonia molecule. II. M. MIZUSHIMA. *J. Phys. Soc. Japan*, **4**, 191–6 (*July–Dec.*, 1949).

The wave functions are classified into + and − types and factorized into vibrational and rotational parts. The intermolecular potential is expressed as a 2nd order perturbation when the intermolecular distance is large. Calculations of the half-width and frequency shift in the inversion-spectrum agree well with experiment. J. JACOBS

539.132 : 535.37

5994. On the significance of impulsive electron excitation for the dynamics of molecular fields of organic compounds. H. SCHUELER, L. REINEBECK AND A. WOELDIKE. *Ann. Phys., Lpz.*, **6**, 110–16 (1949) *In German.*

Emission spectra of organic molecules in glow-discharge are examined. Short-lived free radicals occur in an excited state when the molecule splits into two parts. The similarity of these radical spectra with phosphorescence spectra suggests the radicals are responsible for the latter. A barrier effect is observed due to mass distribution in the molecule; this is connected with fluorescence phenomena. This leads to a new viewpoint regarding the localization of an excitation in part of a molecule. J. JACOBS

539.132 : 536.7

5995. Energy levels and thermodynamic properties of the internal rotator. J. O. HALFORD. *J. Chem. Phys.*, **18**, 444–8 (*April*, 1950).

To facilitate the calculation of the thermodynamic properties of internal rotators lying outside the limits of available tabulations, methods of determining the energy levels are studied for the purpose of finding the most expeditious route to accurate results. It proves to be unnecessary in any case to calculate many levels from the wave mechanics. A partition function is set up in terms of the correct ground state and a series of approximate levels derived from the old quantum theory, and this is corrected to constancy by the successive substitution of correct levels, starting with the first excited state. A set of levels obtained in this way which gives the correct partition function always leads to correct values of all the thermodynamic properties. To obtain accurate energy levels, the continued fractions of Koehler and Dennison are recommended as most convenient. A.

539.132 : 541.57

5996. Excited electronic levels in conjugated molecules. V. A valence bond estimation of energy levels in aromatic hydrocarbon molecules. G. R. BALDOCK. *Proc. Phys. Soc., Lond. A*, **63**, 585–91 (*June*, 1950).

This note is concerned with the calculation of the energy of the ground state and the lowest excited state for hydrocarbons of the condensed ring type.

The difference between these two energies is the energy of the first electronic transition. The normal valence bond method is used, taking only the Kekulé structures into consideration. The results are compared with the experimental absorption wavelengths, and are in good agreement, giving a value of the exchange integral α between $-1{\cdot}8$ and -2 eV. A.

539.132 : 541.65 : 535.343.3–31

5997. Relation between bond structure and the longest ultra-violet absorption band of polycyclic aromatic hydrocarbons. J. W. Cook, R. Schoental and E. J. Y. Scott. *Proc. Phys. Soc., Lond. A*, **63**, 592–8 (*June*, 1950).

A comparison has been made between the values expressed in wave numbers of the longest ultra-violet absorption bands of a series of polycyclic aromatic hydrocarbons and the minimum number of quinonoid rings contained in their molecules. It is found that the hydrocarbons fall into series of groups related to this number of quinonoid rings. A.

539.132 : 548.7

5998. On the non-orthogonality problem connected with the use of atomic wave functions in the theory of molecules and crystals. P. O. Löwdin. *J. Chem. Phys.*, **18**, 365–75 (*March*, 1950).

The treatment of molecules and crystals by the Heitler–London method or by the collective electron model can be based on the atomic orbitals of the system. These orbitals are in general overlapping, and the corresponding overlap integrals are shown to be of essential importance in molecules and in crystals. The problem is solved by considering the orthonormalized functions as the real atomic orbitals. The solution is worked out in detail for (1) the molecular orbital method of treating molecules, (2) the Bloch orbital method of treating crystals, and (3) the Heitler–London method of treating both these systems in some simple spin cases. Some numerical applications are given for ionic crystals, showing that the overlap effects are responsible for all the repulsive forces in these solids. It is also shown that the overlapping adds interesting new features to the properties of molecules and crystals, namely the "many-orbital-effects," corresponding to certain "many-body-forces" in ionic solids. A.

539.132 : 548.7

Infra-red activities of four Raman-inactive vibrations in α-quartz. *See Abstr.* 6156

539.133

5999. Calculation and interpretation of the vibrational potential function of the molecules NH_3 and AsH_3. J. Duchesne and I. Ottelet. *J. Phys. Radium*, **11**, 119–23 (*March*, 1950) *In French.*

The valency field force constants and interaction constants are evaluated. The signs and magnitudes are consistent with sp_3 hybridization for NH_3 but not for AsH_3. D. H. Whiffen

539.133

6000. A determination of the dipole moment and molecular structure of fluorosilane. A. H. Sharbaugh, V. G. Thomas and B. S. Pritchard. Letter in *Phys. Rev.*, **78**, 64–5 (*April* 1, 1950).

539.

6001. The moments of inertia of molecules w internal rotation. P. Torkington. *J. Chem. Ph* **18**, 407–13 (*April*, 1950).

The moments of inertia of some typical molecu with one internal rotational degree of freedom obtained for all possible configurations; also directions of the axes of least and greatest iner The dependence on the values of the structu parameters is discussed and illustrated.

539.133 : 537.22

6002. Molecular dipole moments and Stark effe III. Dipole moment determinations. R. G. Shulm B. P. Dailey and C. H. Townes. *Phys. Rev.*, 144–8 (*April* 15, 1950).

Dipole moments of 8 molecules were determi by the Stark splittings of the rotational transiti in the microwave region. The molecules and th moments in Debye units are: AsF_3, $2{\cdot}815 \pm 0{\cdot}0$ CH_3I, $1{\cdot}647 \pm 0{\cdot}014$; CH_3Cl, $1{\cdot}869 \pm 0{\cdot}0$ CH_3Br, $1{\cdot}797 \pm 0{\cdot}015$; CH_3CF_3, $2{\cdot}321 \pm 0{\cdot}0$ PF_2, $1{\cdot}025 \pm 0{\cdot}009$; N_2O, $0{\cdot}166 \pm 0{\cdot}002$; a ClCN, $2{\cdot}802 \pm 0{\cdot}020$. In all cases Stark effe followed very closely theoretical expectations.

539.133 : 539

An electron-diffraction investigation of nitro trifluoride. *See Abstr.* 4396

539.133 : 548.7

Molecular structure of anthracene. *See Abstr.* 61

539.133 : 548.7

Molecular structure of 1 : 4-dimethoxybenzen *See Abstr.* 6186

ATOMIC STRUCTURE . ISOTOPES 539.

539.15

6003. The effect of the nuclear field on the motion the electrons. D. Ivanenko and V. Rodiche *Dokl. Akad. Nauk, SSSR*, **70** (*No.* 5) 801–4 (1950) *Russian.*

An additional exchange effect between nucleo and electrons is postulated; this explains the isotop shift and phenomena depending on the effecti spread of nucleonic charge, and the effective size the nucleus. It is shown that the binding constan fall into two groups, those connected with the di sociation of nucleons, and those of attraction betwee nucleons and electrons. J. Jaco.

539.152

6004. On the dependence of nuclear radii on th atomic weight. E. Amaldi and B. N. Cacciapuot *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat* **2**, 243–6 (*March*, 1947) *In Italian.*

The nuclear radius is defined as the distance fro the centre of the nucleus at which a force begins t act on a fast neutron. Nuclear radii were measure for 19 elements of atomic number between 4 and 8 It was attempted to fit experimental results on to curve $R = b + r_0A^{1/3}$, where A is the atomic weig and b represents a surface effect. The best values

the constants were determined by applying statistical considerations and found to be: $b = 0{\cdot}696 \pm 0{\cdot}083\ 10^{-13}$ cm; $r_0 = 1{\cdot}52 \pm 0{\cdot}02\ 10^{-13}$ cm. However, the discussion shows that the distribution of the experimental deviations is extremely unlikely, thereby indicating that the law connecting R and A must have a more complicated expression. L. PINCHERLE

539.152.1

6005. Nuclear shell models. E. FEENBERG. *Phys. Rev.*, **77**, 771–6 (*March* 15, 1950).

The principal features of the several shell models now under discussion are described briefly. The magnetic moments of odd nuclei have been interpreted as (*a*) supporting an extreme single particle model (Schmidt limits), and (*b*) as generally consistent with a uniform model (Margenau–Wigner limits). The evidence is consistent with a composite interpretation based on (*a*) the approximate validity of the extreme single particle model for nuclei lacking one particle to make a closed shell or possessing one particle in excess of the number making up a closed shell, and (*b*) the approximate validity of the uniform model for all other odd nuclei. Remarks on quadrupole moments, isomerism and β-decay supplement an earlier discussion. A.

539.152.1

6006. Nuclear configurations in the spin-orbit coupling model. I. Empirical evidence. M. G. MAYER. *Phys. Rev.*, **78**, 16–21 (*April* 1, 1950).

An extreme one-particle model of the nucleus is proposed, based on the succession of energy levels of a single particle in a potential between that of a 3-dimensional harmonic oscillator and a square well: (1) strong spin-orbit coupling leading to inverted doublets is assumed; (2) an even number of identical nucleons are assumed to couple to zero angular momentum, and (3) an odd number to the angular momentum of the single odd particle; (4) a (negative) pairing energy, increasing with the j value of the orbit is assumed. With these four assumptions all but 2 of the 64 known spins of odd nuclei are satisfactorily explained, and all but 1 of the 46 known magnetic moments. The two spin discrepancies are probably due to failure of rule (3). The magnetic moments of the 5 known odd-odd nuclei are also in agreement with the model. The existence, and region in the periodic table, of nuclear isomerism is correctly predicted. A.

539.152.1

6007. Nuclear configurations in the spin-orbit coupling model. II. Theoretical considerations. M. G. MAYER. *Phys. Rev.*, **78**, 22–3 (*April* 1, 1950).

The assumption of short-range attractive forces between identical nucleons in the jj coupling model of nuclear structure is in agreement with the empirically observed spins. A.

539.152.1

6008. The possible existence of a constant third-order difference among the nuclear magic numbers. F. A. VALENTE. Letter in *Phys. Rev.*, **78**, 77–8 (*April* 1, 1950).

539.152.1

6009. Theoretical studies in nuclear structure. I. Enumeration and classification of the states arising from the filling of the nuclear *d*-shell. H. A. JAHN. *Proc. Roy. Soc. A*, **201**, 517–44 (*May* 23, 1950).

Using a simple method due to Racah, the orbital states arising from the filling of the nuclear d-shell in Russell–Saunders coupling are enumerated and, again following Racah, a new classification of the states introduced according to their transformation properties under the group of rotations in the 5-dimensional space of the orbital states of a single d-particle. This new classification acquires significance from the short-range nature of nuclear forces and permits of predictions relating to the order of the levels with attractive forces of short range. A.

539.152.1 : 539.163.2

6010. Neutron binding energies in Pb^{207}, Pb^{208} and in Bi^{210}. B. B. KINSEY, G. A. BARTHOLOMEW AND W. H. WALKER. Letter in *Phys. Rev.*, **78**, 77 (*April* 1, 1950).

Neutron capture γ-rays were measured with the aid of a pair spectrometer. Simple spectra were obtained for Pb and Bi as in the case of the lightest elements. Bi gave a single line at $4{\cdot}170 \pm 0{\cdot}015$ MeV while Pb gave lines at $6{\cdot}68 \pm 0{\cdot}04$ MeV and $7{\cdot}37 \pm 0{\cdot}02$ MeV, attributed respectively to capture in Pb^{206} and Pb^{207}. The narrow Pb lines are assumed to be due to groundstate transitions (thus yielding the values of the neutron binding energies), while the broad Bi line is believed to arise from transitions to several low energy levels. The ratio of σ_c for thermal neutrons in Pb^{207} to that in Pb^{206} was found to be ~ 7. L. R. SHEPHERD

539.152.2

6011. Spins of nuclei with protons and neutrons of odd numbers. G.-J. BÉNÉ, P.-M. DENIS AND R.-C. EXTERMANN. *Arch. Sci.*, **2** (*No.* 3) 549–52 (1949) *In French.*

A simple rule is given, that the spin of a nucleus with equal and odd numbers of both n and p is the sum of the spins of neighbouring nuclei with either the same number of p or of n. This rule is also true for some magnetic moments. Further rules are given when the numbers of p and n are not equal.

G. J. KYNCH

539.152.2

6012. Relative nuclear moments of H^1 and H^2. E. C. LEVINTHAL. *Phys. Rev.*, **78**, 204–13 (*May* 1, 1950).

An accurate determination of the relative moments of proton and deuteron has been carried out, using the techniques of nuclear induction, together with a measurement of the spin and the sign of the deuteron moment. The different line shapes of the proton and deuteron signals have been explained in terms of relaxation times and spins. Symmetrical signals have been obtained by a systematic way of introducing a homodyning signal of the correct phase. The symmetry of the separate and superimposed signals, and hence the occurrence of resonance at a common value of the d.c. magnetic field, were determined by photographic analysis. The ratio of the moments of proton and deuteron has been found to be $\mu_P/\mu_D = 3{\cdot}257204 \pm 0{\cdot}000015$ or $\mu_D/\mu_P = 0{\cdot}3070117 \pm 0{\cdot}0000015$. The facts that the spin of the deuteron

is $j = 1$ and that the sign of its magnetic moment is positive have been verified. A.

539.152.2 : 535.343.4–14

6013. On the nuclear spin of B^{10}. M. T. Weiss, M. W. P. Strandberg, R. B. Lawrance and C. C. Loomis. *Phys. Rev.*, **78**, 202–4 (*May* 1, 1950).

From measurements on the fine structure of the $J = 0 \rightarrow 1$ rotational transition of $H_3B^{10}CO$ near 17 960 Mc/s it is established that the spin of B^{10} is 3 as had previously been reported by Gordy, Ring and Burg. A quadrupole coupling constant of $3{\cdot}44 \pm 0{\cdot}1$ has also been determined for this molecule. A brief description of the spectroscope is included. A.

539.152.2 : 538.222 : 536.63

6014. Nuclear specific heats in paramagnetic salts. B. Bleaney. *Phys. Rev.*, **78**, 214–15 (*May* 1, 1950).

This paper considers theoretically the contribution to the specific heat arising from the hyperfine structure, i.e. from the interaction of the magnetic moment and electric quadrupole moment of the nucleus with its surroundings. This contribution is important only at low temperatures, where it is approximately of the form A/T^2. The coefficient A is calculated for a number of Cu, Mn and Co salts. Agreement with the limited amount of experimental data available is reasonably good. The influence of the hyperfine structure on the magnetic susceptibility is negligible unless the temperature is exceedingly low, for even in single crystals it begins only with terms of the 3rd order in a series development in $1/T$. In manganese ammonium sulphate, the electronic Stark splitting deduced from paramagnetic resonance at 20° and 90°K does not agree with that obtained from the paramagnetic anisotropy between 90° and 300°K. A.

539.152.2 : 539.155.2

6015. Nuclear magnetic moments of the gallium isotopes. G. J. Béné, P. M. Denis and R. C. Extermann. Letter in *Phys. Rev.*, **78**, 66 (*April* 1, 1950).

539.153 : 523.877

6016. Relativistic Thomas–Fermi atom. R. P. Singh. *Indian J. Phys.*, **24**, 19–22 (*Jan.*, 1950).

A relativistic generalization of the well-known Thomas–Fermi equation for the density of electronic charge in an atom, as a function of distance, is worked out and its importance in the study of the internal conditions prevailing in a white-dwarf star has been pointed out. A.

539.153 : 523.877

6017. A new stable state of the negative hydrogen ion. E. Hylleraas. *Astrophys. J.*, **111**, 209–13 (*March*, 1950).

The existence of a second stable state of the negative hydrogen ion has been proved. It corresponds to the doubly excited $(2s)(2p)^3P$ state of He with energy $-1{\cdot}506$ in Rydberg units. The energy of the state has been calculated both for He and H^- with neglect of the mutual polarization energy of the two electrons. As to the distortion of the electron orbits also, mainly that of the s-electron has been taken into account. The binding energy of the second electron is in this approximation about $0{\cdot}29$ eV, but it may possibly be considerably larger. A.

539.153 : 530.

6018. The calculation of quantum defects in isoelectronic series based on polarization concep H. A. Robinson. *Ark. Fys.*, **2**, *Paper* 8, 61–7 (195

The classical method for obtaining absolute te values is to fit terms of running total quantu number n to a Rydberg or Ritz series. But often sufficient number of terms cannot be found, a where large values of n and high stages of ionizati are involved, the experimental accuracy of wavelen measurement may not be high enough to give accura term values. Methods for extrapolating effecti quantum numbers along an isoelectronic sequen would, therefore, be convenient, and such a meth (for non-penetrating orbits) is described. Use made of the deviation of the absolute values from t corresponding hydrogenic values. A. Harv

539.154

6019. The position of the cis- and trans-uran elements in the periodic system: uranides or actinide M. Haissinsky. *J. Chem. Soc.* (*Suppl. No.* 2) S241 (1949).

Reasons are advanced against the classification the cis-uranic elements in a new rare-earth seri the actinides.

539.154.2 : 539.1

6020. Element 97. S. G. Thompson, A. Ghiors and G. T. Seaborg. Letter in *Phys. Rev.*, **77**, 838 (*March* 15, 1950).

A 4·8 hr activity decaying by electron captu with $\sim 0{\cdot}1\%$ α-branching was obtained by He io bombardment of Am^{241} in a 60 in cyclotron. T isotope prepared in this way is thought to be 97^{243} 97^{244}. Separation was made by precipitation and io exchange absorption methods, making use of th properties expected of this element by virtue of i position in the actinide series. The name berkeliu (Bk) is suggested for element 97. L. R. Shepher

539.154.2 : 539.

6021. Periodicity of the mechanical properties elements. B. B. Gulyaev. *Dokl. Akad. Nauk, SSS* **70** (*No.* 5) 797–9 (1950) *In Russian.*

An attempt has been made at systematizing dat relating to mechanical properties of elements i accordance with the periodic table. Tensile strengt is plotted against hardness (Brinell and Mohs scale giving a more or less continuous curve. Whe plotting the strength, relative elongation and elasticit modulus of (annealed) elements at room temperatur against the atomic number, periodic curves have bee obtained, with one maximum in short periods an two maxima in long periods. F. Lachma

539.154.3 : 548.

6022. The atomic magnetic moments of transitiona metals and their alloys and the interatomic distance in their crystal lattices. F. M. Galperin. *Izv. Akad Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 5) 574–95 (1949) *I Russian.*

The basic relationship for the atomic magneti moment of a metal, $m = M + K_1(d_1 - D) + K_2(d_2 - D)$, is discussed, a theoretical explanation i terms of $s - d$ electron transition or exchange being given. $M = 2(10 -$ no. of group in periodic system$)$ K_1 and K_2 are constants, d_1 and d_2 are the distance

from the atom considered to its nearest and next nearest neighbours and D is the sum of the radii of the s and d orbits [Abstr. 2953 (1947)]. Suitable modification permits the calculation of m from published structural data for pure metals and their solid solutions [Abstr. 138 (1947)] and for martensite and Ni_3Mn, Ni_3Fe, $MnCu_2Al$ and CrTe as examples of partially and completely ordered alloys. In most cases calculated and observed moments agree to within 1 to 5%. A. L. MACKAY

539.155

6023. Report of the Committee on Atomic Weights of the American Chemical Society. E. WICHERS. *J. Amer. Chem. Soc.*, **72**, 1431–2 (*April*, 1950).

The International Atomic Weights list for 1949 is given, together with a list of names and symbols of 8 new elements.

539.155

6024. Masses of Cr^{50}, Cr^{52} and Fe^{54}. H. E. DUCKWORTH AND H. A. JOHNSON. Letter in *Phys. Rev.*, **78**, 179 (*April* 15, 1950).

539.155.2

6025. A redetermination of the relative abundances of the isotopes of carbon, nitrogen, oxygen, argon and potassium. A. O. NIER. *Phys. Rev.*, **77**, 789–93 (*March* 15, 1950).

Essentially pure samples of A^{36} and A^{40} have been produced by thermal diffusion and used for the preparation of synthetic A isotope mixtures whose A^{36}/A^{40} isotope abundance ratios were very accurately determined. The mixtures were then employed for determining the mass discriminating effects in two mass spectrometers. C, N, O, A and K were investigated and new values given for the relative abundances of the isotopes. With atmospheric O as a standard, the conversion factor between the physical and chemical atomic weight scales is $1{\cdot}0002783 \pm 5$. The percentage abundance of K^{40} in K is found to be $0{\cdot}0119 \pm 0{\cdot}0001\%$, approximately 10% > the present accepted value. A.

539.155.2

6026. The occurrence of heavy odd-odd isotopes in nature. A. BRONIEWSKI. Letter in *Phys. Rev.*, **77**, 846–7 (*March* 15, 1950).

539.155.2 : 539.152.2

Nuclear magnetic moments of the gallium isotopes. *See Abstr.* 6015

RADIOACTIVITY . α-, β- and γ-RAYS 539.16

539.16.08

6027. The determination of radon and radium in water. R. B. JACOBI. *J. Chem. Soc.* (*Suppl. No.* 2) S314–18 (1949).

Equipment was required which would measure activities of the order of $0{\cdot}1\ \mu\mu$-curie. The experimental procedure involves the separation of the Rn dissolved in the water sample and its transference to the ionization chamber for measurement, and the concentration of the Ra into a solution of small bulk, from which the Rn may be allowed to accumulate, the Ra being estimated by measuring the amount of Rn so obtained. A.

539.16.08 : 536.62

A microcalorimeter suitable for study of easily absorbed nuclear radiations. *See Abstr.* 5789.

539.16.08 : 537.531.08

6028. A portable battery-operated radiation monitor. F. B. WHITING, D. G. A. THOMAS and J. B. MARSH. *J. Sci. Instrum*, **27**, 157–60 (*June*, 1950).

The design of a new monitor for detecting β-, γ- or X-radiation is discussed. The unit is self-contained and consists of an ionization-chamber/electrometer circuit. It is constructed in a form permitting easy handling, and weighs $3\frac{1}{2}$ lb. Indication is by means of a meter calibrated directly in mr/hr and this calibration holds for γ-ray energies > 150 kV. Sensitivity ranges of 125 mr/hr and 1 250 mr/hr full scale are provided. Battery life is 50 hr operation for the filament cell and 6 months for other batteries. A.

539.16.08 : 537.542

6029. Techniques in radiochemical assay with Geiger–Müller counters. G. B. COOK AND J. F. DUNCAN. *J. Chem. Soc.* (*Suppl. No.* 2) S369–81 (1949).

539.16.08 : 537.542

6030. Measurement of radiocarbon as carbon dioxide inside Geiger–Müller counters. M. L. EIDINOFF. *Analyt. Chem.*, **22**, 529–34 (*April*, 1950).

The measurement of radiocarbon activity as CO_2 admixed with CS_2 vapour has been studied as a quantitative procedure over the pressure range 2 to 175 cm Hg. The counting rate was found to be directly proportional to the quantity of active gas sample. In the region 1 to 4 cm of CO_2 pressure the average deviation from the straight line drawn through the origin for 11 measurements was less than 1·2%. At a total pressure of about 50 cm the average deviation of 7 measurements from the straight line drawn for counting rate versus moles of standard active sample was 0·4%. Plateau lengths over 200 V with slopes usually less than 2% per 100 V are obtained over the threshold counting range of 1 500 to about 8 000 V. The gas trains and apparatus for conversion of $BaCO_3$ to CO_2 showed negligible memory effects and permitted precise measurement of the quantity of CO_2 inside the counter tube. The construction of Geiger–Müller counter tubes and auxiliary equipment is described. A.

539.16.08 : 771.535

6031. Method of measuring the path length and the frequency of secondary groups [of nuclear particles] by means of photographic emulsions. M. NAJAR. *Bull. Soc. Vaud. Sci. Nat.*, **64** (*No.* 275) 367–78 (1949) *In French.*

The various standard methods are discussed and a refined method used for the determination of the path length of α-particles from Sm. W. F. BERG

539.163

6032. Studies of neutron-deficient radioactive isotopes. G. WILKINSON. *J. Chem. Soc.* (*Suppl. No.* 2) S360–3 (1949).

The technique of investigation of neutron-deficient radioactive isotopes, produced by use of a 60 in cyclotron, and some preliminary results are recorded. A.

539.163

6033. Radioactive dysprosium isotopes. F. D. S. Butement. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 532–7 (*May*, 1950).

A new isotope of dysprosium, identified as Dy^{166}, has been studied. It has been shown that it is formed by thermal neutron capture in the 140 min isomer of Dy^{165}, the capture cross-section being about 1 200 barns. It decays with a half-life of 82 hr and is the parent 27 hr Ho^{166}. It emits β-particles, the energy of which was found by absorption in Al to be 0·22 MeV, and γ-rays of < 50 keV energy. Another new isotope, Dy^{159}, has been made both by slow neutron irradiation of dysprosium and by deuteron bombardment of terbium. It decays by orbital electron capture, with a half-life > 50 days. A.

539.163

6034. The radioactivity of fluorine 20. J. V. Jelley. *Proc. Phys. Soc., Lond. A*, **63**, 538–9 (*May*, 1950).

The decay scheme proposed by earlier authors is amended as a result of later measurements.

539.163.2

6035. The branching ratio between β^+ emission and K-capture: allowed transitions. II. R. Bouchez, S. R. de Groot, R. Nataf and H. A. Tolhoek. *J. Phys. Radium*, **11**, 105–18 (*March*, 1950) *In French.*

The Dirac electron theory is used to calculate the total transition probabilities P_+ and P_K for positron emission and for K-capture, using the 5 different interactions. For allowed transitions going to the same final level, P_K/P_+ can be expressed as a function of known or calculable quantities. Good agreement between theory and expt. is demonstrated for the transitions $Cd^{107} \rightarrow Ag^{107*}$, $Cu^{64} \rightarrow Ni^{64}$, and $Cu^{61} \rightarrow Ni^{61}$. (The last of these exhibits branching, of which account must be taken in making the theoretical analysis.) An account of some new expts. with Cu^{61} is given, yielding $P_K/P_+ = 0{\cdot}38 \pm 0{\cdot}08$. [See Abstr. 5625 (1949)]. A. P. French

539.163.2 : 539.152.1

6036. Scarcity of states of Li^7, from magnetic observation of $Be^9(d, \alpha)\,Li^7$. D. R. Inglis. *Phys. Rev.*, **78**, 104–9 (*April* 15, 1950).

The alpha-spectrum of the reaction $Be^9(d, \alpha)\,Li^7$ was observed at a bombarding energy 600 keV. Above the well-known 480 keV excited state of Li^7 there is no further excited state, having a transition as much as 5% as intense as the ground-state transition, in the range of excitation energies up to 2·5 MeV; and from there, where the $(d, 2\alpha)$ reaction begins to obscure the observations, up to 3·6 MeV there is no sharp line more than 10% as intense as the ground-state line. The observations were made with a magnetic heavy-particle spectrograph giving an extended spectrum with a 2nd-order focus on a photographic plate. A.

539.164

6037. Alpha-particles from $^{27}Al + D$. A. P. French and P. B. Treacy. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 665–6 (*June*, 1950).

539.164 : 537.562

The ionization in argon and in air by single alpha-particles as a function of their energy. *See Abstr.* 5901

539.164

6038. α-decay systematics. G. Wilkinson. *Chem. Soc. (Suppl. No. 2)* S364–5 (1949).

Recent work in the laboratories at Berkeley reviewed, and consideration of a large number nuclei emitting α-particles has enabled many of t phenomena to be correlated. In particular, t relations between α-particle energy and mass numbe and between $\frac{1}{2}$-life and energy in α-decay, are inves gated.

539.164.8 : 537.5

Determination of alpha particle energies wi scintillation counters. *See Abstr.* 5896

539.1

6039. Determination of the maximum energy of t β-rays from 16-hour Am^{242}. J. M. Grunlun B. G. Harvey, N. Moss and L. Yaffe. Letter *Phys. Rev.*, **78**, 69–70 (*April* 1, 1950).

539.1

6040. An absorption comparison of the β-partic spectra of $^{207}_{81}AcC''$ (allowed), $^{210}_{83}RaE$ (second fo bidden) and 3·5 yr.-$^{204}_{81}Tl$ (third forbidden). H. I Evans. *Proc. Phys. Soc., Lond. A*, **63**, 575–85 (*Jun* 1950).

Direct comparison experiments are describe New values of 623 ± 4 mg/cm² and 300 ± 3 mg/cm are proposed for the absorption limits in Al of t β-particles emitted by AcC'' and Tl and it is show that, of the 3 elements, RaE emits most and AcC least low energy electrons. An attempt has bee made to derive energy distributions from the absorp tion curves, but the results for RaE depart marked from those obtained with magnetic spectrograph The general findings, however, agree with those c other workers who have attempted the same procedur

539.165 : 539.16

6041. Beta-gamma angular correlation. T. E Novey. Letter in *Phys. Rev.*, **78**, 66–7 (*April* 1, 1950)

Sources were mounted on 0·6 mg/cm² rubbe hydrochloride films in an evacuated plastic chambe and coincidence rates measured (with 0·08 μse resolving time) at 0° and 90°, using scintillatio detectors (a thick anthracene crystal for γ-rays an thin, 30 mg/cm² crystal for β-particles). Assuming $1 + \varepsilon \cos^2\theta$ correlation function, the value of ε wa determined for several radioactive isotopes. A valu of $\varepsilon = -0{\cdot}259 \pm 0{\cdot}053$ was obtained in the bet decay of Tm^{170} (after filtering out K-X-rays from th γ-detector, with 1 g/cm² Cu). Other results were $\varepsilon = +0{\cdot}003 \pm 0{\cdot}015$ for Co^{60} β–γ correlation $\varepsilon = +0{\cdot}006 \pm 0{\cdot}026$ for Sc^{46} β–γ correlation $\varepsilon = +0{\cdot}130 \pm 0{\cdot}040$ for Sc^{46} γ–γ correlation an $\varepsilon = +0{\cdot}035 \pm 0{\cdot}020$ for the β–γ correlation i Rb^{86}, from which Cs^{134} impurity had been carefull removed in an ion exchange column. L. R. Shepher

539.16

6042. Angular distribution of annihilated γ-quanta N. A. Vlasov and B. S. Dzhelepov. *Dokl. Akad Nauk, SSSR*, **70** (*No.* 2) 207–10 (1950) *In Russian.*

An apparatus is schematically described fo investigating the angular distribution of annihilate γ-quanta, whereby more detailed conclusions coul be drawn than was possible previously [*Dokl. Akad*

Nauk, SSSR, **59** (*No.* 7) 879 (1948)] as to the energy of the positrons. Two banks of counters each consisting of 6 counters were placed at a distance of 53 cm from a complex source of annihilated γ-rays, viz. Cu^{64} wrapped up in Pb foil. One of the banks could be rotated around an axis passing through the source and the number of coincidences measured for different counter positions. In order to obtain a narrow pencil of γ-rays, both banks of counters were placed in separate Pb cradles, in the forward 3 cm thick walls of which (i.e. the walls directly facing the source) a canal was made 0·8 mm wide, aligned along the axis of the counters. The results obtained indicated that the majority of the pairs of annihilated quanta are scattered in opposite directions at an angle θ, which differs from 180° by $< 1°$. If $180 - \theta = \phi$, then for no less than half of the pairs, ϕ varies between 0 and 0·3° which indicates that a very considerable share of the positrons before annihilation have a kinetic energy of < 10 eV. Since a calculation of the actual angular distribution cannot be effected at the present time because the energy spectrum of positrons decelerating in the material is unknown in the energy interval of a few eV, only a simplified analysis of the angular distribution according to the Dirac formula is considered. It is shown from experimental data that annihilation of pairs with very low total impulse has a considerably greater probability than would be expected on the Dirac formula. W. HUGHES

539.166

6043. Internal conversion and energies of γ-lines from Co^{60}. K. SIEGBAHN AND M. DEUTSCH. *Ark. Fys.*, **2**, *Paper* 3, 9–15 (1950).

Internal conversion lines corresponding to the two hard γ-radiations from Co^{60} were observed in a large double focusing β-spectrometer. Sources (2 and 8 mg/cm² thick) were of sufficient specific activity to make the internal conversion effect $\gg$ external photo effect in the source material. The observed energies of the conversion lines and of photoelectron lines from a thin Pb radiator led to a new estimate of the γ-ray energies, viz. 1·174 MeV and 1·1338 MeV. The total internal conversion coefficients for these radiations were found to be $2{\cdot}32 \times 10^{-4}$ and $1{\cdot}83 \times 10^{-4}$ respectively. It is suggested that both transitions are of the electric quadrupole type. L. R. SHEPHERD

539.166

6044. Ultra-sensitive portable gamma-ray spectrometer. R. W. PRINGLE, K. I. ROULSTON AND G. M. BROWNELL. *Nature, Lond.*, **165**, 527 (*April* 1, 1950).

Using a 100 g scintillation crystal the instrument detects down to 10^{-10} r/sec and acts as a proportional counter, so identifying different gamma-ray energies. Total weight is 8 lb and the instrument will detect uranium ores at a distance of several hundred feet. The background is small, and it has been used successfully for aerial surveys. F. T. FARMER

539.166

6045. A precise determination of the energy of the Cs^{137} gamma-radiation. L. M. LANGER AND R. D. MOFFAT. Letter in *Phys. Rev.*, **78**, 74–5 (*April* 1, 1950).

539.166

6046. On the $\gamma-\gamma$-angular correlation in Pd^{106}. J. A. SPIERS. Letter in *Phys. Rev.*, **78**, 75–6 (*April* 1, 1950).

539.166

6047. Energies of some gamma-rays from ThC″, RaC, and Na^{24}. J. L. WOLFSON. Letter in *Phys. Rev.*, **78**, 176–7 (*April* 15, 1950).

539.166.08 : 537.534

6048. Measurement of polar diagram of synchrotron gamma radiation. D. J. LEES AND L. H. METCALFE. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 661 (*June*, 1950).

539.166.08 : 778.3

6049. Determination of the energy of high-energy γ-rays by the photographic method. D. T. KING. *Nature, Lond.*, **165**, 526–7 (*April* 1, 1950).

NUCLEAR REACTIONS 539.17

539.172

6050. The relationship between the size of nuclear disintegration stars and the mean energy of the emitted particles. K. J. LE COUTEUR. *Proc. Phys. Soc., Lond. A*, **63**, 498–501 (*May*, 1950).

Nuclear evaporation theory predicts that the mean energy of the protons evaporated from disintegration stars should increase with star size. It is shown that the calculated rate of increase is in agreement with experimental results. A.

539.172.1

6051. The reactions of high-energy particles with nuclei. G. WILKINSON. *J. Chem. Soc.* (*Suppl. No.* 2) S366–9 (1949).

The use of the new 184 in cyclotron, which affords deuterons and α-particles of much higher energy than hitherto available, has given a far more complex mixture of isotopes than the smaller cyclotrons. This has necessitated a reconsideration of the mechanisms involved in atomic fission. A.

539.172.1

6052. Neutrons from the bombardment of Li^6 by deuterons. W. WHALING AND J. W. BUTLER. Letter in *Phys. Rev.*, **78**, 72–3 (*April* 1, 1950).

539.172.1

6053. Neutron groups from the reaction $Li^7(p, n)Be^7$. B. HAMERMESH AND V. HUMMEL. Letter in *Phys. Rev.*, **78**, 73–4 (*April* 1, 1950).

539.172.1

6054. Nuclear transmutations of carbon-13. C. D. CURLING AND J. O. NEWTON. Letter in *Nature, Lond.*, **165**, 609–10 (*April* 15, 1950).

Reactions produced in a film of carbon 13 ($\sim 0{\cdot}05$ mg/cm²) have been investigated by bombardment with protons and deuterons up to 1 MeV. The 554 keV resonance was observed in $C^{13}(p, \gamma)N^{14}$. Rapid variations of angular distribution of the long-range protons with deuteron energy (430–980 keV) were observed in $C^{13}(d, p)C^{14}$, and the energy release was determined as $5{\cdot}91 \pm 0{\cdot}03$ MeV by comparison with $Be^9(d, p)Be^{10}$. A low energy proton group, if assigned to $C^{13}(d, p)C^{14}$, suggests an

excited state of C^{14} at $5{\cdot}59 \pm 0{\cdot}04$ MeV. The excitation function of the long-range proton group was compared with that of α-particles from $C^{13}(d,\alpha)B^{11}$; the comparison suggests that different energy levels in the compound nucleus are involved in the (d,p) and (d,α) reactions. T. G. PICKAVANCE

539.172.1

6055. The neutrons emitted in the bombardment of ^{6}Li by deuterons. W. M. GIBSON AND L. L. GREEN. *Proc. Phys. Soc., Lond. A*, **63**, 494–8 (*May*, 1950).

The neutrons from deuteron bombardment of a separated Li^6 target have been studied by the photographic plate method. The energy release for the reaction $Li^6 + D \rightarrow Be^7 + n$ has been shown to be $3{\cdot}40 \pm 0{\cdot}05$ MeV, and evidence is given for the existence of a level in Be^7 at 450 ± 60 keV. This is identified with the level at 430 keV found in work on the reaction $B^{10}(p,\alpha)Be^7$. A.

539.172.1

6056. Alpha-particles from ^{19}F bombarded with deuterons. A. P. FRENCH, P. MEYER AND P. B. TREACY. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 666–8 (*June*, 1950).

539.172.1

6057. The energy-release in some (pα) reactions in light nuclei. J. M. FREEMAN. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 668–9 (*June*, 1950).

539.172.1 : 778.3

6058. Photographic plate evidence for the γ*p*-reaction in Be^9. E. W. TITTERTON. Letter in *Nature, Lond.*, **165**, 721–2 (*May* 6, 1950).

Using Be-loaded photographic plates irradiated with a 24 MeV betatron the author reports on 21 events showing triple stars interpreted by the 3-stage reaction $Be^9(\gamma,p)Li^8$, $Li^8(\beta)Be^{8*}$, $Be^{8*} \rightarrow 2He^4$. The cross-section of the first stage over the energy range 18–24 MeV is $2{\cdot}5 \pm 1{\cdot}0 \times 10^{-28}$ cm^2. A histogram of the total energy release in the break-up of the excited Be nucleus indicates a broad level somewhat higher than 3 MeV. Evidence for the $Be^9(\gamma,n)$ reaction was sought, but the findings are not regarded as proving its existence. W. F. BERG

539.172.13

6059. The production by the cyclotron of some useful radio-nuclides. J. W. IRVINE, JR. *J. Chem. Soc.* (*Suppl. No.* 2) S356–60 (1949).

The production of Na, Mn, Fe and Zn radionuclides by use of 10–20 MeV deuterons is described. A.

539.172.13 : 539.185

6060. Neutron production in various substances by 50-Mev X-rays. G. C. BALDWIN AND F. R. ELDER. Letter in *Phys. Rev.*, **78**, 76–7 (*April* 1, 1950).

539.172.3

6061. The photo-disintegration of carbon into three alpha-particles. F. K. GOWARD, V. L. TELEGDI AND J. J. WILKINS. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 402–4 (*April*, 1950).

Stars from the reaction $C^{12}(\gamma, 3\alpha)$ were produced in photographic plates with γ-rays, of peak energy ~ 25 MeV, from a synchrotron. From an analysis of 216 stars it is shown that most of the disintegrations proceed via the 3 MeV, Be^8 level. A few stars were interpreted as involving the ground state of Be^8, a a level about 8 MeV. J. HUGH

539.17

6062. Photo-neutron thresholds of titanium a chromium. W. E. OGLE AND R. E. ENGLAND. Lett in *Phys. Rev.*, **78**, 63 (*April* 1, 1950).

539.17

6063. The Cu^{63} photo-neutron threshold. MCELHINNEY AND W. E. OGLE. Letter in *Phys. Re* **78**, 63 (*April* 1, 1950).

539.17

6064. Thresholds for the photo-disintegration Zr^{90}, Pr^{141}, As^{75}, I^{127}, and Ni^{58}. W. E. OGLE, L. BROWN AND A. N. CARSON. Letter in *Phys. Rev.*, 7 63–4 (*April* 1, 1950).

539.17

6065. Photo-alpha-reactions in oxygen and nitroge C. H. MILLAR AND A. G. W. CAMERON. Letter *Phys. Rev.*, **78**, 78–9 (*April* 1, 1950).

539.17

6066. Dipole transitions in the nuclear photo-effec J. S. LEVINGER AND H. A. BETHE. *Phys. Rev.*, 7 115–28 (*April* 15, 1950).

Sum rules are applied to calculate under certai approximations the integrated cross-section and th mean energy for photon absorption by heavy nucle In section II the summed oscillator strength for dipo transitions is calculated as $\Sigma_n f_{on} = (NZ/A)(1 + 0{\cdot}8$ where x is the fraction of attractive exchange forc for the n–p potential. For $N = Z$ this gives the cross section integrated over photon energy $\int_0^\infty \sigma dW =$ $0{\cdot}015A(1 + 0{\cdot}8x)$ MeV barns. In section III th mean energy $\overline{W}$ for photon absorption is calculate The mean energy is 4/3 the average kinetic energy of nucleon for pure ordinary forces, or about 19 MeV and is greatly increased by attractive exchange force The harmonic mean energy

$$W_H = \Sigma_n f_{on}/[\Sigma_n f_{on}/(E_n - E_0)]$$

is much too low using the model of uncorrelate nucleons, but is reasonable if the α-particle model o the nucleus is used. In section IV a sum rule fo quadrupole transitions is developed, and quadrupol transitions are shown to account for only about 6% of the experimentally observed integrated cross section. In section V the sum rules for dipol transitions are applied to the photo-disintegration o the deuteron, and the results compared from sum rules with those from direct calculations of the cross-section. In section VI the asymptotic behaviou of the cross-section for dipole transitions at high photon energies is determined by the nature of the singularities in the n–p potential. Finally the experiments on the cross-section for photo-dis integration, and its energy dependence, are discussed [Abstr. 2566 (1948); 1527 (1949)] and the calculations are found to explain the general features of the experiments. It is not necessary to assume the Goldhaber–Teller model of dipole vibrations by the entire nucleus. A.

539.172.3

6067. Identification of photo-disintegration stars in nuclear emulsions. F. K. GOWARD AND J. J. WILKINS. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 662–3 (*June*, 1950).

539.172.3

068. Identification of nitrogen photo-disintegration ars in nuclear emulsions. J. J. WILKINS AND F. K. OWARD. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 53–5 (*June*, 1950).

539.172.4

069. The mode of operation of the uranium reactor. . LILJEBLAD. *Ark. Fys.*, **2**, *Paper* 4, 17–25 (1950). An examination of the degree to which the U may e utilized in a homogeneous or lattice reactor of atural U under idealized conditions.

L. R. SHEPHERD

539.172.4

070. Engineering aspects of nuclear reactors. IV. . A. OHLINGER. *Nucleonics*, **6**, 46–57 (*March*, 1950). The conversion into useful power of the heat enerated in nuclear reactors is discussed. Open and losed cycles are considered with particular reference o possible aircraft applications including turboprop, urbojet, ramjet and rocket propulsions. The roblems of controlling these power plants are out- ned. A brief review of the availability of nuclear uels and limitations on the use of nuclear power is iven.

L. R. SHEPHERD

539.172.4

071. Controlling a power-producing nuclear reactor. . M. HARRER. *Nucleonics*, **6**, 58–65 (*March*, 1950). The time dependence of neutron density in a eactor is described as a function of k (the effective umber of neutrons produced per neutron absorbed n or escaping from the reactor). Transient response urves are given for the case of a supercritical reactor ith values of δk (i.e. $k - 1$) of 0·001, 0·002, 0·003 nd 0·004, taking delayed neutrons into account. simple single loop servo system for controlling the eutron density is discussed. This incorporates a B onization chamber for the neutron density measure- ent and a suitable control rod to produce or ompensate for changes in k. The main requirements f suitable ion chambers and control rod drives are utlined.

L. R. SHEPHERD

539.172.4

072. Radioactivity in platinum by neutron capture. . M. CORK, A. E. STODDARD, W. C. RUTLEDGE, . E. BRANYAN AND J. M. LEBLANC. Letter in *Phys. ev.*, **77**, 843 (*March* 15, 1950).

Pile-irradiated Pt yielded an 82 d half-life activity n addition to previously reported 3·4 d and 17·4 hr ctivities. This was found to consist of 0·54 MeV -particles (determined by Al abs.) and 0·6 MeV -radiation (by Pb abs.) and is assumed to be an somer of Pt^{197} or Pt^{199}, probably the former. The ·4 d Au^{199} which follows the decay of 31 m Pt^{199} as examined in β-spectrometers and > 20 con- ersion lines were observed. These are attributed to transitions ranging in energy from 65·0 keV to 57·6 keV.

L. R. SHEPHERD

539.172.4

073. Possible emission of the dineutron in fission. . W. FENNING AND F. R. HOLT. Letter in *Nature, ond.*, **165**, 722 (*May* 6, 1950).

539.172.4 : 539.155.2

074. The fission yield of Xe^{133} and fine structure n the mass yield curve. J. MACNAMARA, C. B. COLLINS AND H. G. THODE. *Phys. Rev.*, **78**, 129–34 (*April* 15, 1950).

A mass spectrometer investigation of the Xe isotopes formed from U^{235} fission has been made and the fission yield and half-life of Xe^{133} determined. The fission gases were extracted, purified, and the mass spectrometer abundance data obtained within 2 weeks of the end of the irradiation period. The fission yield of Xe^{133} was found to be $6{\cdot}29 \pm 0{\cdot}01\%$, which is 20% higher than that expected from the mass yield curve. This is further evidence of fine structure in the mass fission yield curve. The half-life value of Xe^{133} was found to be $5{\cdot}270 \pm 0{\cdot}002$ d. A.

539.172.4 : 539.164

6075. Angular correlation in the reaction $B^{10}(n, \alpha)Li^{7}(\gamma)Li^{7}$. B. ROSE AND A. R. W. WILSON. Letter in *Phys. Rev.*, **78**, 68 (*April* 1, 1950).

539.172.4 : 771.535

The application of photographic plates for the detection of the fission reactions of uranium. *See Abstr.* 6190

ATOM AND MOLECULE BEAMS . MESONS NEUTRONS 539.18

539.18

6076. The interaction of pi-mesons. O. PICCIONI. Letter in *Phys. Rev.*, **78**, 78 (*April* 1, 1950).

An answer is given to some criticisms of the author's conclusion that the absorption length of π-mesons is $> 1\,400$ g/cm^2. [Abstr. 3233–4 (1950)].

E. P. GEORGE

539.18 : 535.1

6077. Production of nuclear mesons (spin 0) by photons. P. BENOIST-GUEUTAL, J. PRENTKI AND J. RATIER. *C.R. Acad. Sci., Paris*, **230**, 1146–8 (*March* 20, 1950) *In French.*

The production of mesons by 335 MeV photons and in particular the excess of negative mesons is examined in the Born approximation for scalar and pseudoscalar mesons assuming the nucleons to obey the Dirac equation. The more satisfactory agreement with experiment is obtained for pseudoscalar mesons.

J. G. WILSON

539.18 : 537.591.8

Positive excess and multiple production of mesons. *See Abstr.* 5938–9

539.18 : 537.591.8

Nuclear cross-sections of high energy pi-mesons. *See Abstr.* 5940

539.181 : 538.114

6078. Theory of scattering of hydrogen atomic ray by the ferromagnetic substance. T. HIRONE AND N. TSUYA. *J. Phys. Soc. Japan*, **3**, 260–4 (*July–Aug.*, 1948).

It is shown that in the H atomic ray the magnetic scattering is completely screened out by the electronic scattering and that the scattering cross-section due to electric interaction is of the order of 10^{-12} cm^2 per atom. The theory also shows that the cross-section of scattering under a paramagnetic state is about 10% greater than under an unmagnetized state,

of the ferromagnetic substance. Experimental confirmation of this calculated difference would give evidence of the existence of domain structure even in the unmagnetized state of the ferromagnetic solid.

G. F. HODSMAN

539.185

6079. Diffraction effects in the scattering of fast neutrons. E. AMALDI, D. BOCCIARELLI, B. N. CACCIAPUOTI AND G. C. TRABACCHI. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **1,** 29–34 (*Jan.*, 1946) *In Italian.*

The diffraction effects are produced by potential scattering. A systematic investigation was carried out of the scattering of ~ 14 MeV neutrons, the detector threshold being at 11 MeV. The total cross-section, the absorption cross-section and the angular distribution of the scattered particles were measured. From the position of the first diffraction minimum the value $8{\cdot}7\times10^{-13}$ cm was deduced for the radius of the Pb nucleus. L. PINCHERLE

539.185

6080. Scattering of 90 MeV neutrons by alpha-particles. J. HEIDMANN. *Phil. Mag.*, **41,** 444–57 (*May*, 1950).

Using the Born approximation and the nucleon-nucleon interaction introduced by R. Serber, calculations are made of: (i) the inelastic scattering, especially for the collision in which a deuteron is produced by stripping; (ii) the elastic scattering, estimating the errors due to the Born approximation. No measurements being available on scattering of 90 MeV neutrons by He, deduction of values for comparison with the calculations is attempted from measurements on neutron-carbon and neutron-oxygen collisions; this is done using the α-particle model for these nuclei. A.

539.185

6081. Neutron-deuteron scattering at high energies. F. DE HOFFMANN. *Phys. Rev.*, **78,** 216–20 (*May* 1, 1950).

Stationary-state perturbation theory is applied to the problem of *n–d* scattering at high neutron energies. The Born approximation is used and exchange, but not tensor, forces are considered. It is shown that the *n–d* cross-section, even in the case of general exchange forces, is made up of 3 distinct contributions: the cross-sections for the scattering of the incoming neutron from the bound proton or neutron, respectively, averaged over the momentum distribution of the particle in the deuteron; and the cross-terms due to interference and the Pauli principle. A.

539.185

6082. On the scattering of polarized neutrons by protons. A. B. BHATIA. *Proc. Phys. Soc., Lond. A,* **63,** 502–14 (*May*, 1950).

The scattering and the consequent depolarization of a polarized beam of neutrons by an unpolarized proton gas is suggested as a means of obtaining information about the interaction potential between a neutron and a proton. It is found that the interaction, if it were spherically symmetrical, could be determined from a knowledge of the polarization and scattering differential cross-sections. A similar analysis with non-central interaction has not yet been carried out. In this case, however, the pola tion depends also on the azimuth ϕ of scatte This dependence of polarization on ϕ is calcul for (*a*) very low energies, (*b*) very high energies. maximum azimuthal variations for incident neut of energy 1 MeV and 100 MeV are about 1% 50% respectively.

539.185 : 523

Nuclear reactions of astrophysical importa Formation of neutrons. *See Abstr.* 5475

539.185 : 53

6083. Influence of radiation damping on the neut proton scattering at relativistic energies. D. B *Proc. Roy. Irish Acad. A,* **53,** 31–9 (*Feb.*, 1950).

Numerical values of the scattering cross-sec are given for values of E from 100 to 20 000 M For $E > 500$ MeV, the theoretical value is 1 barns. At energies $> 1\,000$ MeV, this is presuma smaller than the cross-section for meson product E. P. GEO

539.185 : 539

6084. Statistical theory of the ferromagnetic su lattice. III. Elastic scattering of slow neutr T. MUTŌ. *J. Phys. Soc. Japan,* **4,** 316–18 (*July–D* 1949).

Theoretical. Deduces an expression for scattering cross-section of slow neutrons, tak separate account of the nuclear and magnetic scat ing. No detailed discussion is attempted since expression includes a logarithmically diverg integral, but results are given, on an arbitrary sc for the variation with temperature of the nuclear magnetic components. J. THEV

539.185 : 539.172

Neutron production in various substances by 50-M X-rays. *See Abstr.* 6060

539.185

6085. A comparison of some absolute methods measuring fast neutron flux. K. W. ALLEN, D. LIVESEY AND D. H. WILKINSON. *Proc. Camb. P Soc.*, **46** (*Pt II*) 339–53 (1950).

A critical survey of the methods, and their in comparison using *d–d* neutrons, is given. The res obtained by the various methods for the angu distribution of the *d–d* neutrons are compared w the theoretically expected value. The scope a future applications of the methods presented briefly discussed. J. HUG

539.185.08 : 771.53

6086. The measurement of neutron fluxes and of relative value of an action cross-section by the pho graphic method. C. HAENNY AND O. KLEME *Bull. Soc. Vaud. Sci. Nat.*, **64** (*No.* 274) 297–306 (19 *In French.*

The method of determining neutron fluxes means of photographic emulsions impregnated w B or Li is studied in some detail. The method used to determine the relative cross-sections of and B. W. F. BE

539.18

6087. The exact calculation of neutron slowing-do lengths. W. BOTHE. *Ann. Phys., Lpz.* (*Folge* 6) 52–61 (1948) *In German.*

This was done taking into account the relati

ween the scattering angle and the energy loss for a gle collision. Both integral and series representa- ns are obtained for the slowing down length. and heavy moderators are considered, as well as influence on the slowing down length of collisions ich are elastic and isotropic in the centre of gravity tem. J. HUGHES

539.185.7

38. Calculation of the energy deposition by fast itrons in soft tissue. J. H. TAIT. *Brit. J. Radiol.*, , 282–6 (*May*, 1950).

The dose in röntgen (rep) is calculated at interior ints of a semi-infinite space consisting of human sue, for the case when a broad monochromatic limated beam of neutrons falls perpendicularly on the free surface. The variation of the mean e path with energy is neglected, and with this proximation the physical effects can be shown to proportional to the neutron energy flux. This ter quantity is then determined as a function of distance into the tissue using the Spherical rmonics P_7 approximation. A.

STRUCTURE OF SOLIDS 539.2

539.2 : 536.6 : 537.3

89. A calorimetric and resistometric study on the nsformations in AuCu. J. NYSTRÖM. *Ark. Fys.*, **2**, *per* 16, 151–9 (1950).

Measurements were made of the heat evolved ring the order-disorder transformation of AuCu a function of temperature and time; specific results en include the rate of evolution of heat, P, and total heat, U. It is found that P varies as t^3; the nperature variation of U is compared with that lculated by Borelius [Abstr. 1253 (1950)]. From resistance measurements at various temperatures is concluded that orthorhombic AuCu II has a gher resistance than tetragonal AuCu I. The nsition between these two modifications was also vestigated; the transformation velocity between uCu I and II was found to be smaller than that tween the ordered and disordered states. The easurements are compared with earlier X-ray vestigations of Källbäck *et al.* [Abstr. 973 (1944)].

E. P. WOHLFARTH

539.214 : 539.382

90. The part of octahedral theory in the study of plasticity of metals. W. P. ROOP. *J. Franklin st.*, **249**, 223–36 (*March*, 1950).

A discussion supporting the use of octahedral lues in defining the basic stress(σ)/strain (ε) relation- p. The use of phase space on this basis is explained, -ordinates of a point being the 3 principle σ's for t point in geometrical space. Taking one of the nciple σ's = 0, the usefulness of the approach is monstrated by various diagrams representing tahedral data: e.g. contours of octahedral σ and al σ with hoop ε and axial ε as co-ordinates (a rticular, parabolic equation is taken for the curve). An application in the presentation of cture data is briefly noted. A. J. KENNEDY

539.217

6091. The self-diffusion of silver and mercury in Ag_2HgI_4. K. E. ZIMEN, G. JOHANSSON AND M. HILLERT. *J. Chem. Soc.* (*Suppl. No.* 2) S392–4 (1949).

Two methods for the determination of self-diffusion coefficients by means of radioactive tracers are discussed. Preliminary experiments are described in which these methods are applied to the species named in the title. A.

539.217

6092. Self-diffusion in some solids. R. LINDNER. *J. Chem. Soc.* (*Suppl. No.* 2) S395–6 (1949).

A preliminary account is given of experiments in which radioactive tracers have been used to determine self-diffusion constants. A.

539.23

6093. Structure of thin films of silver and silver iodide on silver bromide substrates. C. R. BERRY. *Acta Cryst.*, **2**, 393–7 (*Dec.*, 1949).

The electron-diffraction reflection method has been used to examine thin deposits formed on large single crystals of AgBr. Ag films were prepared by evaporation and AgI was formed by reaction of the AgBr with dilute solutions of KI and of a CNI sensitizing dye. The various orientations and structures of these deposits can be accounted for by assuming that the coating layers are built up by a disordered stacking of close-packed layers on minute octahedral faces of the substrate. Comparison is made with related observations previously reported by others. A.

539.23 : 535.39

6094. Two theorems referring to thin films and their applications. F. ABELÈS. *C.R. Acad. Sci., Paris*, **230**, 632–3 (*Feb.* 13, 1950) *In French.*

If a stratified transparent medium presents a plane of symmetry between two layers of the same medium then a simple relation is obtained for the difference in changes of phase suffered at reflection and at transmission. This difference is given in terms of the refractive index and thickness of the film. The formula offers a method for measuring thin films. It is shown that the relation $r_{\parallel}t_{\perp}/r_{\perp}t_{\parallel}$ (in which r and t are reflection and transmission coefficients for the respective polarizations) is independent of the film thickness, providing it is not zero or infinity.

S. TOLANSKY

539.234

6095. Cryolite film on the glass. N. MORITA. *J. Sci. Res. Inst., Tokyo*, **44**, 127–37 (*Feb.–March*, 1950).

The problem of tenacity of a thin evaporated film of cryolite on glass was investigated with respect to the following points: (1) the effect of temperature of the glass during deposition upon the tenacity of the film; (2) the effect of the residual gas molecules; (3) the effect of temperature of the evaporating source. A.

539.234 : 535.39

Structure of evaporated metal films. *See Abstr.* 5741

539.26 : 535.37

X-rays in the development of inorganic phosphors. *See Abstr.* 5717

539.27

6096. A simple apparatus for the preparation of collodion replicas for electron microscopy. L. GRÜN AND W. TISCHER. *Optik*, **6**, 129–32 (*March*, 1950) *In German.*

Describes a fitting for attachment to a light microscope which allows the collodion film to be pressed against any desired small area of the object (bacterial colony, etc.) while keeping the object under microscopical observation. A. H. W. BECK

ELASTICITY . STRENGTH . RHEOLOGY
539.3/.8

539.3

6097. Theory of elasticity for finite displacement. II. S. SUGAMOTO. *J. Phys. Soc. Japan*, **4**, 348–9 (*July–Dec.*, 1949).

539.31

6098. Anisotropy, symmetry, heterogeneity in elasticity. A. BRODEAN. *Publ. Sci. Min. Air, France* (*No.* 229) 61 *pp.* (1949) *In French.*

This report is a continuation of *Publ. Sci. Min. Air, France* (*No.* 201). Instead of establishing a general mathematical theory and then making applications to particular cases, the author has preferred to establish the theory of certain particular cases. Chapter headings are: Résumé of fundamental ideas about deformable solids, notations and conventions; Elastic phenomenon near the surface separating two bodies with different mechanical properties but both homogeneous and isotropic; Isotropic non-homogeneous bodies; Fibro-stratified bodies separated by a surface parallel to a common plane of symmetry, the other planes of symmetry being also common; Non-homogeneous fibro-stratified bodies; A fibro-stratified body in contact with any anisotropic body; Fibro-stratified bodies placed symmetrically with respect to the surface; Fibro-stratified body with symmetry variable in space; Study of crystals. Some photographs of actual crystals are included but the remainder of the paper is purely mathematical.

INDEX AERONAUTICUS

539.32 : 539.216

6099. Studies on the elasticity of cellulose fibers. I. B. W. ASMUSSEN AND F. ANDERSEN. *Trans. Danish Acad. Tech. Sci.* (*No.* 5) 32 *pp.* (1947).

II. F. ANDERSEN. *ibid.* (*No.* 6) 14 *pp.* (1947).

539.32 : 548.0

6100. The elastic constants of germanium single crystals. W. L. BOND, W. P. MASON, H. J. MCSKIMIN, K. M. OLSEN AND G. K. TEAL. Letter in *Phys. Rev.*, **78**, 176 (*April* 15, 1950).

539.32 : 548.0

Elastic constants of nickel crystals. *See Abstr.* 6133

539.37 : 548.0

6101. Inhomogeneity of deformation in metal single crystals. R. W. K. HONEYCOMBE. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 672–3 (*June*, 1950).

539.373 : 548.0

Rotational slip—a new deformation process in crystals. *See Abstr.* 6134

539.374

6102. Surface effects and the plasticity of crystals. S. HARPER AND A. H. COTTRELL. *Phys. Soc., Lond. A*, **63**, 331–8 (*May* 6, 1950).

The effects of various surface treatments on plastic properties of Zn crystals are exam Roscoe's observation of the hardening effect surface film of oxide is confirmed; electrolyti polished specimens have critical shear stress about 33 g mm^{-2} whereas oxidized specimens values up to 65 g mm^{-2}. Similar effects observed on the rate of creep under constant st The Rehbinder effect—softening crystals by imme them in paraffin and oleic acid—can be produce oxidized specimens but not on others. Oxi specimens do not respond instantly to imme and the time of response is proportional to viscosity of the liquid. It is suggested that the li penetrates the oxide film and reduces its abilit harden the metal; the action of the oxide film is not yet clear.

539.4 :

6103. On the stresses and energies associated inter-crystalline boundaries. J. H. VAN DER ME *Proc. Phys. Soc., Lond. A*, **63**, 616–37 (*June*, 195

Models, largely based on the assumptions in duced by Peierls and Nabarro in dealing wi single dislocation, are used in calculations on 3 t of intercrystalline boundaries, namely, (1) a boun due to a difference of atomic spacing, (2) a boundary, and (3) a symmetrical tilt bound With these models the resolution of the boun into a sequence of dislocations is a natural consequ of the analysis, which also yields the expressions the stresses, atomic displacements and energies a ciated with the boundary, as functions of the a of tilt, etc. By allowing the distance between d cations to tend to infinity, these expressions re to the corresponding ones for single dislocati The outstanding feature of the interfacial energ that it increases initially very rapidly with the a of tilt, etc. An application of the results to theory of oriented overgrowths, developed by F and the present author is described. The validit the assumptions and approximations involved the advantages of the treatment as compared those of other writers are discussed.

539.4.01 :

6104. Yield points in zinc crystals. H. L. WAIN A. H. COTTRELL. *Proc. Phys. Soc., Lond. A*, 339–45 (*May* 6, 1950).

It is shown that sharp yield points can be produ in crystals of Zn containing N. The gas is introdu in a preliminary melting operation, either by bubb it through the metal or by allowing it to be abso from the atmosphere, using a flux to keep the sur clean. Strain ageing treatments are needed to deve the yield point clearly, but once it is develope returns at the same level after each successive tr ment at the same temperature. Ageing experim at room temperature show that overstrained crystals soften by recovery before the yield p returns; Zn differs from Fe in this respect. Gen conditions for producing yield points in metals common crystal structures are briefly discussed.

539.434

105. A simple constant stress apparatus for creep sting. L. M. T. HOPKIN. *Proc. Phys. Soc., Lond.*, **63**, 346–9 (*May* 6, 1950).

A simple device is described which can maintain ne stress on a creep specimen constant to within 0·8% uring uniform extensions up to 100%. The appara- is is suitable for slow rates of strain. Examples are iven of creep curves obtained with this device from sts on Pb and a Pb–Sn alloy extending to 1 000 and 00 hr respectively; good agreement with the Andrade reep equation is observed in both cases. A.

539.5 : 539.154.2

Periodicity of the mechanical properties of elements. *ee Abstr.* 6021

539.501 : 532.13 : 535.55

Optical methods for the study of structural change in ubricants. *See Abstr.* 5752

539.501 : 532.133

106. The second viscosity coefficient in rheological ystems. R. C. L. BOSWORTH. *Aust. J. Sci. Res. A*, **3**, 394–404 (*Sept.*, 1949).

Viscosity in liquids may be regarded as that property vhich corresponds to elasticity in solid systems, and he coefficient of viscosity is expected to show as nany independent components as the modulus of lasticity. For isotropic systems two components are expected. These two components are denoted by η and ξ. The Stokes relationship between the two coefficients, viz. $\zeta = -\frac{2}{3}\eta$ is compared with the Cauchy–Poisson relationship between the two moduli of elasticity of an isotropic solid, and is claimed as of no more general application. Indeed, experience in sound absorption leads to the conclusion that $\zeta \gg \eta$, and many measurements on the viscosity of plastic materials appear tacitly to assume that $\zeta = \infty$. ζ, however, has a finite value for systems which undergo a progressive change in density at constant pressure. For such systems it is shown that the coefficient of viscosity, as determined by a tensile testing method, while always less than that as determined by torsion testing methods is greater than two-thirds of the latter value. The bulk viscosity, measured by the bulk stress required to produce a progressive density change, is shown to be related to the difference between the shear (or torsional) and the tensile (or flexural) viscosities. Measurements of all three viscosities carried out on a specimen of solid carbon dioxide gives a satisfactory agreement with the theory of small deformations. A.

539.62

6107. Influence of interfacial potential on friction and surface damage. F. P. BOWDEN AND L. YOUNG. *Research, Lond.*, **3**, 235–7 (*May*, 1950).

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM . CHEMICAL REACTIONS 541.11/.12

541.124

5108. On the quantum theory of kinetics. M. SHIMOJI. Letter in *J. Chem. Phys.*, **18**, 394–5 (*March*, 1950).

541.124 : 519.2

5109. Remark on the statistical ensembles in the variables pressure, temperature and chemical potentials. I. PRIGOGINE. *Physica*, **16**, 133–4 (*Feb.*, 1950) *In French.*

An equation is derived whereby the transformation from the variables V, T, μ_Y (chemical potential) to p, T, μ_Y in a statistical ensemble, can be made.

T. C. TOYE

541.124 : 519.2

5110. The fluctuations of chemical equilibrium. I. PRIGOGINE. *Physica*, **16**, 134–6 (*Feb.*, 1950) *In French.*

The chemical reaction $A + B \rightleftharpoons C$ is considered and it is shown that by utilizing De Donder's formula for the second derivative of G (Gibbs's free energy) with respect to ξ (the degree of advancement of the reaction) a formula is obtained giving the fluctuation of the numbers of molecules of the constituents. The argument can be extended to the case of r simultaneous chemical reactions. T. C. TOYE

541.126

5111. Activation in processes in the sensitiveness of explosives. A. R. UBBELOHDE. *Research, Lond.*, **3**, 207–12 (*May*, 1950).

ELECTROCHEMISTRY 541.13

541.132 : 537.226

Special case of exchange action between dipoles and ions in an electrolyte solution and its relationship to the dielectric constant of the solvent. *See Abstr.* 5806

541.135.5 : 539.155.2

6112. The electrolytic separation factor of tritium. J. HORIUTI AND T. NAKAMURA. Letter in *J. Chem. Phys.*, **18**, 395–6 (*March*, 1950).

PHOTOCHEMISTRY . RADIATION CHEMISTRY 541.14

541.14

6113. The yields by fast and slow neutrons in a Szilard–Chalmers reaction. E. BRODA AND W. RIEDER. *J. Chem. Soc.* (*Suppl. No.* 2) S356 (1949).

541.14 : 548.7 : 772.1

6114. Lattice disturbances and the photochemistry of silver bromide containing impurities. O. STASIW. *Ann. Phys., Lpz.*, **5** (*No.* 3–5) 151–62 (1949) *In German.*

The effect of melting di-valent S or Pb ions into AgBr on the spectral absorption was determined at high (290 to 380°C) and room (18°C) temperature. The results are discussed on the assumption that the crystal defects in AgBr are of the Frenkel type. The

addition of PbS should not affect the equilibrium of the lattice defects, whereas the addition of any one of the ions does. Pb ions do not produce a measurable change in absorption. Beer's law is fulfilled with respect to the concentration of sulphide ions. Crystals prepared with the addition of Ag_2S give an absorption similar to those containing PbS at high temperature, but at room temperature the Pb ion causes a considerable drop in the absorption coefficient due to the sulphide ions. The detailed explanation of these effects is reserved for another paper. W. F. BERG

DISPERSIONS . COLLOIDS ADSORPTION 541.18

541.182.2

6115. The measurement of airborne droplets by the magnesium oxide method. K. R. MAY. *J. Sci. Instrum.*, **27**, 128–30 (*May*, 1950).

A complete calibration has been made for the first time of the method of detecting and measuring airborne droplets whereby the permanent impressions made when they strike a layer of MgO smoked on a glass slide are measured microscopically. A size range of 200 to 10 μ and a wide range of liquids and impact velocities were investigated, and it was found that the ratio of true drop size to impression size is constant at 0·86 for droplets $> 20\ \mu$ of any liquid. The method fails below 10 μ. The calibration was made against an absolute method of droplet measurement, also against the so-called "focal-length" method. Droplets of any desired size were generated by a uniform spray apparatus. A.

541.183

6116. Surface films of copolymers. A. J. G. ALLAN AND A. E. ALEXANDER. *Trans. Faraday Soc.*, **46**, 316–27 (*April*, 1950).

541.183

6117. Statistical mechanics of adsorption. IX. Adsorption thermodynamics and solution thermodynamics. T. L. HILL. *J. Chem. Phys.*, **18**, 246–7 (*March*, 1950).

A generalization of Part V [Abstr. 5758 (1949)]. It is shown that the usual solution thermodynamics can be recast into an equivalent but alternative form which is more natural and useful in adsorption work. Relations between the two systems of thermodynamics are pointed out. The extension to the case of sorption from a mixture of gases is included. A.

541.183 : 539.13 : 536.75

The entropy of adsorbed molecules. *See Abstr.* 5796

CHEMICAL STRUCTURE 541.4/.6

541.5

6118. The lower valency states of thorium. J. S. ANDERSON AND R. W. M. D'EYE. *J. Chem. Soc.* (*Suppl. No.* 2) S244–8 (1949).

541

6119. A new valency of protoactinium. G. BOUISSIÈRES AND M. HAISSINSKY. *J. Chem. Soc.* (*Suppl. No.* 2) S256–8 (1949).

541

6120. Metallic valences. A. I. SNOW. Letter in *J. Chem. Phys.*, **18**, 233 (*Feb.*, 1950).

In Hume-Rothery's investigation of the effect of Mn, Fe and Ni on the α/β brass equilibrium [Abstr. 1685 (1948)] the assumption was made that the metallic valences of Cu, Zn and Al are 1, 2 and 3 respectively. It is shown here that if this assumption is discarded, the valences suggested by Pauling [*Phys. Rev.*, **54**, 899 (1938) and Abstr. 1917 (1947)] form a self-consistent set satisfying Hume-Rothery's experimental results. R. B. DINGLE

541.6 : 534.321.

Effect of ultra-sound on the phenomenon of orthotropism in organic substances. *See Abstr.* 5638

541.64

6121. On the theory of the high polymer solutions. H. ICHIMURA. *J. Phys. Soc. Japan*, **3**, 308–11 (*Sept.–Dec.*, 1948).

541.64

6122. Relaxation phenomena of polymers. III. Motion of junctions under stress relaxation. H. TOHARA. *J. Phys. Soc. Japan*, **4**, 222–7 (*July–Dec.*, 1949).

541.64

6123. Statistical theory of linear polymers. V. Paraffin-like chain. R. KUBO. *J. Phys. Soc. Japan*, **4**, 319–22 (*July–Dec.*, 1949).

See Abstr. 6523–6 (1949).

541.64

6124. Changes of entropy and heat content during polymerization. F. S. DAINTON AND K. J. IVIN. *Trans. Faraday Soc.*, **46**, 331–48 (*April*, 1950).

541.64 : 539.13 : 532.77

Second-order and mesh distribution functions of cross-linked polystyrenes. *See Abstr.* 5578

LABORATORY APPARATUS 542.1/.7

542.2

6125. Liquid air level control. M. S. FRED AND E. G. RAUH. Letter in *Rev. Sci. Instrum.*, **21**, 258 (*March*, 1950).

CHEMICAL ANALYSIS 543/545

545.8 : 539.16

6126. The emanation method. O. HAHN. *J. Chem. Soc.* (*Suppl. No.* 2) S259–74 (1949).

545.81

6127. Chromatographic analysis. *Disc. Faraday Soc.* (*No.* 7) 336 *pp.* (1949).

Symposium of 43 papers with discussions.

545.82

128. Some considerations in the design of double-eam analyzers for industrial control. G. KIVENSON. . *Opt. Soc. Amer.*, **40**, 112–18 (*Feb.*, 1950).

The design and constructional features of infra-ed and ultraviolet double-beam analysers are iscussed. Various optical and electronic arrange-ients are described and the most commonly used ethods of evaluation listed. Some recommendations or future research have been made. A.

545.82

129. Rapid routine calculation of multicomponent ixtures with punched card machines. A. OPLER. *Inalyt. Chem.*, **22**, 558–60 (*April*, 1950).

545.846

130. Electrophoresis and adsorption analysis as aids in the investigation of substances of high molecular weight and of their decomposition products. A. TISELIUS. *Naturwissenschaften*, **37** (*No.* 2) 25–33 (1950) *In German.*

Modern methods are described. The effect of differences in density in the 2-chamber electrophoresis apparatus are minimized by working at 4°C. Cells of square cross-section facilitate the use of optical methods of observation, which are especially useful for following the travel of the interface; and of a pneumatic device to move the cells together horizontally. Interferometry is used to follow the direct, elution and displacement methods of chromatographic analysis. Applications to enzyme chemistry, biological proteins, dyestuffs and general analytical chemistry are described. J. GRANT

CRYSTALLOGRAPHY 548

548 : 537.228.1 : 621.39

131. Quartz, its treatment and employment in elecommunications technique. R. SUEUR, J. NORBERT, . ANDRIEUX AND M. CORNEBISE. *Onde Elect.*, **30**, 67–75 (*Feb.*, 1950) *In French.*

Describes the phenomena of piezoelectricity, the hysical properties of quartz and states the laws of Curie and Lippmann. A mathematical summary hows the application to quartz and an analysis is iven of the equivalent circuit of the crystal when sed as a resonator. A table shows the angles of the nore usual cuts of the crystal. The natural quartz leposits in Madagascar are discussed and classified.

B. B. AUSTIN (R)

548.0 : 535.375.5

Raman spectra of single crystals of potassium ydrofluoride. *See Abstr.* 5728

548.0 : 535.376

Remarks on the luminescence of ionic crystals. *See Abstr.* 5735

548.0 : 535.6 : 537.311.33

Recombination of the electrons of conductivity on he colour centres in crystals. *See Abstr.* 5827

548.0 : 535.6 : 537.311.33

Polarizability of the colour centre. *See Abstr.* 5828

548.0 : 537.226.2

132. Concerning the work of polarization in ionic rystals of the NaCl type. III. Numerical results for single charge in the rigid lattice. F. K. DU PRÉ, . A. HUTNER AND E. S. RITTNER. *J. Chem. Phys.*, **8**, 379–80 (*March*, 1950).

Numerical results determined from the theory resented in Part I [Abstr. 3563 (1949)] are given for 3 substances. A.

548.0 : 537.311.33

Secondary currents in coloured KCl crystals. *See Abstr.* 5834

548.0 : 539.32

133. On elastic constants of nickel crystals. M. YAMAMOTO. Letter in *Phys. Rev.*, **77**, 566 (*Feb.* 15, 950).

548.0 : 539.37

Inhomogeneity of deformation in metal single crystals. *See Abstr.* 6101

548.0 : 539.373

6134. Rotational slip—a new deformation process in crystals. H. WILMAN. Letter in *Nature, Lond.*, **165**, 321–2 (*Feb.* 25, 1950).

Rotational slip is the slipping of one part of a crystal over a neighbouring part so that the two (densely populated) planes sliding over one another are rotated about their common normal axis to one of a series of new positions where metastable equilibrium can occur. Values can be obtained for an azimuthal displacement d corresponding to a high order of density of coincident points in the contact plane. These d values agree closely with observed orientations in a wide variety of crystals.

J. A. FRANKS

548.1

6135. An application of group theory to the analysis of the anisotropy of crystals. N. S. AKULOV AND YA. I. FELDSHTEĬN. *Dokl. Akad. Nauk, SSSR*, **70** (*No.* 4) 593–6 (1950) *In Russian.*

A tensor A describes how vector quantities transform in an anisotropic crystal. When A is expressed as a polynomial function of the components of an arbitrary vector, relations exist between the coefficients of the polynomial. With cubic symmetry, for the 6th degree polynomial describing an even property, there are 10 independent coefficients and for a 2nd degree polynomial in the hexagonal case, there are 6.

A. L. MACKAY

548.24

6136. On the artificial detwinning of quartz. J.-P. PÉREZ. *C.R. Acad. Sci., Paris*, **230**, 849–51 (*Feb.* 27, 1950) *In French.*

In the detwinning of quartz by heating and torsion [Abstr. 1728 (1946)] it is unnecessary to pass through the α–β transition, a temperature 60–100°C lower sufficing, and the torsion need only be applied for a few sec. The detwinning can be detected by the

change in the mode of vibration after application of the torsion, and the quartz wafer cooled immediately.
A. J. C. WILSON

548.3

6137. Crystal chemical considerations of the surface chemistry of silica. W. A. WEYL. *Research, Lond.*, **3**, 230–5 (*May*, 1950).

548.4

6138. Fractography as a technique in crystal chemistry. C. A. ZAPFFE AND C. O. WORDEN. *Acta Cryst.*, **2**, 377–82 (*Dec.*, 1949).

"Fractography" is the technique recently developed in metallurgical fields for studying the patterns found on nascent fracture surfaces at high magnifications of the optical microscope. It is applied here to cleavages of non-metallic crystals to demonstrate its usefulness in disclosing deformation and cleavage mechanisms and in displaying intracrystalline structures, particularly imperfection structures. As with metals, numerous informative patterns are readily found which serve to distinguish crystal types, to reveal the history of growth of the individual crystal, and to provide direct visual evidence for the mosaic constitution of the solid state. A.

548.4

6139. Fractographic study of an ammonium dihydrogen phosphate single crystal. C. A. ZAPFFE AND C. O. WORDEN. *Acta Cryst.*, **2**, 383–5 (*Dec.*, 1949).

The technique of fractography [preceding Abstr.] is applied to the cleavage surfaces of an $NH_4H_2PO_4$ synthetic single crystal, using both dark-field and oblique illumination. Excellent hackle patterns are observed; and other markings are also found which relate to crystallographic deformation mechanisms and to crystal imperfection. These latter are: (*a*) lamellar and blocklike markings suggesting fine-scale crystallographic weakness of a micellar type, (*b*) dendritic formations of unknown origin, (*c*) inclusions of foreign phases, and (*d*) thin textural effects on the cleavage surface. Fractography is accordingly proposed as a tool for studying the perfection of such crystals, also the manner in which they respond to deformation and cleavage. A.

548.4

6140. Further fractographic studies of synthetic single crystals. C. A. ZAPFFE AND C. O. WORDEN. *Acta Cryst.*, **2**, 386–8 (*Dec.*, 1949).

Previous fractographic studies with synthetic $NH_4H_2PO_4$ single crystals are extended to similar crystals containing 5 and 20% of $NH_4H_2AsO_4$, respectively, and to crystals of KH_2PO_4. These materials are found to be distinguishable by their cleavage patterns; and the outstanding characteristic is an optical grating effect occurring in the arsenated crystals. The study proceeds to show that this optical effect is associated with a subtle physical structure having the nature of lamellar texture. The recently announced micellar theory is used to explain the phenomenon on the basis of a layer-like crystal growth of micelles in which the arsenate is unequally distributed between surface and body of the individual micelle, thereby providing an inhomogeneity sufficient in degree and in periodicity to develop the optical effect, also a condition of strain which has been noted by others. A.

548

6141. Static models of dislocations. B. A. BILBY *J. Inst. Met.*, 77, 613–27 (*Feb.*, 1950).

A model is described with which various cryst lattices can be built. These can be deformed elastical and dislocations introduced. With this model th geometry of the motion and arrangement of di locations of various types, and certain results of th elastic theory of dislocations, can be demonstrate Selected examples of dislocations in a simple cub lattice are considered in order to illustrate the sco and limitations of the model.

548

6142. Crystallization of calcium arsenates. A. I BELOPOLSKIĬ AND S. M. SHOGAM. *Zh. Fiz. Khim.*, 22 1266–74 (1949) *In Russian.*

The solid phases in the system As_2O_5–CaO–H_2O were determined at 17°–20°C and 40°–60°C. Repre sentations of the powder diagrams of $3CaO . As_2O_5$ $10H_2O$, $4CaO . As_2O_5 . 5H_2O$, $3CaO . As_2O_5 . 2H_2O$ and some intermediate compositions are given.
A. J. C. WILSO

548.

6143. Radially symmetric phase growth controlle by diffusion. F. C. FRANK. *Proc. Roy. Soc. A*, 201 586–99 (*May* 23, 1950).

Particular solutions of the diffusion equation, wit radial symmetry, in three and in two dimensions found originally by Rieck, represent the diffusion field around a spherical or cylindrical new phase growing from a negligible initial radius in an initiall uniform medium, maintaining equilibrium condition at the growing surface. The resulting diffusion field is most simply described by saying that the radia gradient is the same as that of the correspondin potential problem with fixed boundaries, multiplie by a factor $\exp(-r^2/4Dt)$, where r is radius, D diffusivity, t time. The result is applied to phase growth controlled by the diffusion of heat, solute, o both together. It differs appreciably from the stati approximation unless the supercooling, or the super saturation and the solubility, are small. A

548.52

6144. The overgrowth of copper by its oxide E. MENZEL. *Ann. Phys., Lpz.*, **5** (*No.* 3–5) 163–8 (1949) *In German.*

The growth and orientation of Cu_2O layers on single-crystal Cu spheres was studied at temperature up to 1 000°C after various etching treatments.
A. J. C. WILSON

548.52

6145. Observation of unimolecular growth steps on crystal surfaces. L. J. GRIFFIN. Letter in *Phil. Mag.*, **41**, 196–205 (*Feb.*, 1950).

A line structure on prism faces of beryl crystals was observed by microscope. Evidence is given that the lines represent steps one unit cell in height. The observed structure corresponds to Frank's theoretical model of steps produced by screw dislocations [Abstr. 1343 (1950)]. Frank comments: measurements of the line structure boundaries and of the spacing between turns of a growth spiral yield information regarding the temperature and degree of supersaturation at which crystal growth took place.
J. A. FRANKS

548.52

6. Theory of crystal growth. N. F. MOTT. *ture, Lond.*, **165**, 295–7 (*Feb.* 25, 1950).

Theoretical values of the growth rates of crystals in bour or solution under low supersaturations ained hitherto, were far below the observed rates. ank [Abstr. 5782 (1949)] explained this discrepancy the basis of the theory of dislocations, experintal evidence for which is now provided by otographs of the line structures on prism faces of yl crystals (preceding Abstr.). J. A. FRANKS

548.522

47. "Vapor snake" phenomenon and "plastic stals." S. SEKI. Letter in *J. Chem. Phys.*, **18**, 7–8 (*March*, 1950). See Abstr. 1344 (1950).

548.526 : 771.53

48. Structure and growth mechanism of photolytic ver in silver bromide. C. R. BERRY AND R. L. RIFFITH. *Acta Cryst.*, **3** (*No.* 3) 219–22 (1950).

An investigation has been made by X-ray and ctron diffraction of single crystals of pure AgBr ring the process of photolytic decomposition duced by irradiating the crystals with u.v. light. e orientation of the Ag determined from the X-ray fraction patterns is quite different from the orientans determined from the electron diffraction tterns. This corresponds to differences in the Ag ientations in the body and near the surface of the gBr crystals. Two different mechanisms of Ag paration in these two regions of the crystals, one sed on the motion of cations, and the other on the gregation of *F*-centres, appear to account for the orientations observed. A.

548.54

49. Epitaxial strain and disorientation in crystals owing on single-crystal substrates. D. M. EVANS D H. WILMAN. Letter in *Proc. Phys. Soc., Lond. A*, , 298–9 (*March*, 1950).

548.574

50. The thermal etching of single crystals of dmium. E. N. DA C. ANDRADE AND R. F. Y. ANDALL. *Proc. Phys. Soc., Lond. A*, **63**, 198–208 *March*, 1950).

The heating of single crystal wires of Cd in circumances that permit free evaporation produces a velopment of crystalline planes. When the basal ane makes a small angle with the axis of the wire ere is a characteristic formation of hexagonal pits, e bottoms of which are mirror-like basal planes: hen the basal planes make larger angles, characristic elliptical traces appear, reminiscent of those rmed by mechanical extension. The thermal ching reveals, by the formation of steps, thin minae existing in the unstrained wire; the thickness these, of the order of 1 μ, is the same as the spacing the glide planes revealed by mechanical extension. he etched figures, in general, indicate that the subructure revealed by straining is already present in e unstrained crystal. The secondary pyramidal ces revealed agree with the calculations of Stranski, aischew and Krastanov. The mirror-like basal anes are sufficiently large to permit the application an optical method to reveal a scatter in their clination to the axis. This method shows that there is a variation $\simeq 20$ min, of orientation among the basal planes about the direction of growth of the crystals, which were grown by the method of Andrade and Roscoe and showed good single crystal properties by the usual criteria. A.

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

6151. Electron terms and radiation from atoms in crystals. I. Term-splitting and electric-dipole radiation. II. Magnetic-dipole radiation. III. Electric-quadrupole radiation. IV. Symmetry degeneration and Kramers degeneration. K. H. HELLWEGE. *Ann. Phys., Lpz.* (*Folge* 6) **4** (*No.* 3–4) 95–149 (1948). Erratum: *ibid.* (*No.* 6) 357 (1949) *In German.*

Results previously published [Abstr. 7407 (1949)] are developed in full detail with proofs.

A. J. C. WILSON

548.7

6152. Electron terms and radiation from atoms in crystals. V. Cubic crystals. K. H. HELLWEGE. *Ann. Phys., Lpz.* (*Folge* 6) **4** (*No.* 3–4) 150–60 (1948) *In German.*

Previous results [Abstr. 7407 (1949), 6151 (1950)] are completed by the investigation of the following topics for the 5 cubic crystal classes: symmetry degeneration and quantum numbers of the electron terms; electric potential and Kramers degeneration; selection rules for electric-dipole, magnetic-dipole, and electric-quadrupole radiation. A. J. C. WILSON

548.7

6153. Outer Brillouin zones for the face-centred cubic, body-centred cubic and close-packed hexagonal structures. R. L. BERRY, M. B. WALDRON AND G. V. RAYNOR. *Research, Lond.*, **3**, 195–6 (*April*, 1950).

The second zone for the face-centred cubic cell is bounded by {111}, {200} and {311}, with a volume of just under $8/a^3$, ~ 4 electrons/atom. The radius of the inscribed sphere is $3/2\sqrt{2}a \sim 2{\cdot}49$ electrons/atom. The corresponding data for the body-centred cubic cell are {200}, {211}; $7/a^3$; 7; $1/a$; $4{\cdot}189$. For an [approximately] close-packed hexagonal structure the bounding planes depend on the axial ratio; two zones for titanium ($c/a = 1{\cdot}601$) are illustrated. A. J. C. WILSON

548.7 : 530.162

6154. Measurement of electric fluctuations as a method of studying processes in metals. E. YA. PUMPER. *Izv. Akad. Nauk, SSSR, Ser. Fiz.*, **13** (*No.* 5) 596–614 (1949) *In Russian.*

By using a linear detector with large time-constant, fluctuation processes could be detected in two types of system (ohmic resistance, thermionic tubes) which departed from the normal distribution law; these are related to occasional physical dis-equilibrium processes occurring in the system, and it is suggested that they occur at the expense of lattice energy.

F. LACHMAN

548.7 : 536.421 : 535.343.2

The vibrational spectra of molecules and complex ions in crystals. Ammonium and deutero-ammonium bromide and chloride. *See Abstr.* 5698–9

548.7 : 536.424.1

6155. On the transition in KH_2PO_4. G. SHIRANE AND T. OGUCHI. *J. Phys. Soc. Japan*, **4** (*No.* 3) 172–6 (*March–April*, 1949).

548.7 : 539.132

6156. Infra-red activities of four Raman-inactive vibrations in α-quartz. B. D. SAKSENA AND S. S. BHATNAGAR. *Proc. Indian Acad. Sci. A*, **30**, 308–16 (*Dec.*, 1949).

The electric moments developed during an i.r. vibration have been calculated by supposing that the moments produced may be divided into two parts, one due to bending of bonds and the other due to the stretching of bonds. By taking the stretching moment as $ke \,.\, \Delta r$ acting from Si to O atom where Δr gives the change in bond length, the moments due to all the bonds can be resolved along the axis. It is found that the resolved parts are zero along the x and y directions. The bending moment is given by $ke(\delta_O - \delta_{Si})$, where δ_{Si} and δ_O are the displacements of Si and O atoms and acts along the direction leading from O to Si atom normal to the bond. It is again seen by resolving moments along the axes and adding the results for various bonds that the net moment arises only along the optic axis. The two moments then can be added up. It is then seen that the frequencies 1 160 and 489 have almost the same intensity and 809 is the weakest. A.

548.7 : 539.132

On the non-orthogonality problem connected with the use of atomic wave functions in the theory of molecules and crystals. *See Abstr.* 5998

548.7 : 539.154.3

The atomic magnetic moments of transitional metals and their alloys and the interatomic distances in their crystal lattices. *See Abstr.* 6022

548.7 : 539.4

On the stresses and energies associated with inter-crystalline boundaries. *See Abstr.* 6103

548.73

6157. Intensity of X-ray reflexion from perfect and mosaic absorbing crystals. P. B. HIRSCH AND G. N. RAMACHANDRAN. *Acta Cryst.*, **3** (*No.* 3) 187–94 (1950).

The variation of the integrated Bragg reflection of perfect absorbing crystals with the degree of asymmetry of the reflection, structure factor and wavelength is studied theoretically and compared with that of ideally mosaic absorbing crystals. It is shown that the integrated reflection of a perfect crystal is always < that of a corresponding mosaic crystal. If absorption is very large, or if the reflection is very asymmetric, the integrated reflection of the perfect crystal approaches asymptotically that of the mosaic crystal. Approximate formulae are given for the integrated reflection as a function of asymmetry of the reflection, structure factor and absorption coefficient. It is suggested that accurate determinations of structure factors may be made by the use of asymmetric reflections for which the integrated reflection becomes more nearly independent of texture of the crystals.

548.73 : 537.22

6158. Structure of $BaTiO_3$ at low temperatu R. G. RHODES. *Acta Cryst.*, **2**, 417–19 (*Dec.*, 1949)

Single domain crystals (mosaic below 0°C) $BaTiO_3$ showed large thermal hysteresis effects at transitions near 0° and −90°. Between 0° and − the structure is thought to be either monocli ($a = c = 4{\cdot}018$, $b \simeq 3{\cdot}980$ Å, $\beta = 90°\ 12'$) (Mega or two phases, one tetragonal ($a = b \simeq 3{\cdot}99$ $c = 4{\cdot}018$ Å) and the other monoclinic ($a = b$ $c = 4{\cdot}018$ Å, $\beta = 90°\ 12'$). Below −90° the structu is slightly distorted cubic ($a = b = c = 3{\cdot}999$ $\beta = 90°\ 14'$). A. L. MACK

548.

6159. X-ray interference in systems with disorde stacking. J. MÉRING. *Acta Cryst.*, **2**, 371–7 (*De* 1949) *In French.*

The scattering of X-rays by parallel layers disordered stacking is calculated, taking account the number of layers per stack. The result is a mo general formula than that obtained by Hendricks a Teller for random stacks with infinite numbers layers. Systems with complete or partial randomn are discussed. The latter case comprises cryst with "mistakes." The influence of the nature of t mistakes (accidental shifts, or twinning along certa planes), is studied, as is also the influence of th distribution.

548.732 : 535.42 : 537.5

Calculation of the correction for instrumen broadening in X-ray diffraction lines. *See Abstr.* 58

548.7

6160. A high-temperature Debye–Scherrer X-r camera. E. C. WILLIAMS. *J. Sci. Instrum.*, **27**, 154 (*June*, 1950).

Designed primarily for examination of flat sol specimens with the side-reflection technique. Su specimens are sometimes preferable to powders, an furthermore, they permit of direct temperatu measurement by means of an attached thermo-coupl With solid specimens an appreciable surface ar must be swept periodically past the incident bea and a simultaneous oscillation about the azimut must be imposed in order to bring a large numbe of grains into reflecting positions. For this purpos a mechanism of novel design has been incorporate in the instrument which also provides simple rotatio for powder specimens and independent azimuth oscillation so that the camera may be used for X-ra spectroscopic analysis.

548.73

6161. An integrating Weissenberg apparatus f X-ray analysis. E. H. WIEBENGA AND D. W. SMIT *Acta Cryst.*, **3**, 265–7 (*July*, 1950).

A modification of the ordinary Weissenber apparatus is described. It is possible to measure th integrated reflection intensities with an accuracy equa to, or even better than, that obtained with an inte grating photometer, and in a time comparable wit that required for visual estimation. The modificatio consists of a simple mechanical device by which at th end of every translation the camera is given a sma

tional movement in the direction of its axis and nall rotation. Each reflection is thereby recorded a series of slight displacements in two directions. overlap generates a small parallelogram, the ity distribution in which shows a flat plateau in centre. From this the integrated reflection nsity can be directly obtained. Constructional ils of the integrating mechanism are given and e results are shown. A.

548.734

2. The one-dimensional crystal. I. General.). H. DONNAY AND G. H. DONNAY. *Acta Cryst.*, 66–9 (*Dec.*, 1949).

he electron-density function is considered at a of n^3 equidistant points covering the period of a with high indices $[n^2n1]$, with $n = 1\,000$. This imensional representation of the crystal yields as ch information as the conventional evaluation at n by n by n points of a grid defined by 3 sets of s parallel to the co-ordinate axes. The summation he Fourier series is thereby considerably simplified. function can be evaluated rapidly at isolated nts. The method is also applicable to the cal- ation of structure factors. A.

548.734

3. The one-dimensional crystal. II. A graphical thod for computing structure factors. G. H. NNAY. *Acta Cryst.*, **2**, 370–1 (*Dec.*, 1949).

548.734

4. A new Weissenberg technique using a double . H. P. STADLER. *Acta Cryst.*, **3**, 262–4 (*July*, 50).

Describes a new method of recording the nth and o layers of the reciprocal lattice simultaneously by ans of a Weissenberg goniometer with two screen s. The new method combines the principal vantages of the oscillation and equi-inclination hniques for measuring X-ray intensities by allowing intensities of both layers to be recorded on the ne relative scale. The anti-equi-inclination position used for the zero layer, and the application of the rentz factor and absorption corrections for this sition is discussed. A.

548.734 : 518.5

5. The use of punched cards in molecular ucture determinations. III. Structure-factor cal- ations of X-ray crystallography. J. DONOHUE AND SCHOMAKER. *Acta Cryst.*, **2**, 344–7 (*Dec.*, 1949).

The method is sufficiently flexible to allow its plication to any space group. The principles set th may also be applied to other formerly laborious culations, such as the application of the method east squares to crystal-structure determinations. A.

548.734 : 518.5

6. An improved punched-card method for crystal ucture-factor calculations. M. D. GREMS AND . KASPER. *Acta Cryst.*, **2**, 347–51 (*Dec.*, 1949).

548.734 : 518.5

7. A Hollerith technique for computing three- ensional differential Fourier syntheses in X-ray stal-structure analysis. E. G. COX, L. GROSS AND A. JEFFREY. *Acta Cryst.*, **2**, 351–5 (*Dec.*, 1949).

The method makes it possible to determine the precise positions of the maxima in the electron-density distribution with corrections for "termination of the series" error. It can also be used for computations in the methods of least squares and steepest descents. A.

548.734.8

6168. The probability distribution of X-ray intensities. III. Effects of symmetry elements on zones and rows. A. J. C. WILSON. *Acta Cryst.*, **3**, 258–61 (*July*, 1950).

A symmetry element that causes equivalent atoms to coincide in groups of n in a plane (or line) projection produces a zone (or row) of reflections whose average intensity is $n\Sigma$, where Σ is the sum of the squares of the scattering factors of the atoms in the unit cell. The average for the general reflections is Σ; the difference between the zone (or row) average and the general average may be useful in the purely X-ray determination of space groups. The effects of simple symmetry elements on the probability distribution of the intensities are summarized in two tables. A.

548.734.8

6169. A Geiger-counter technique for the measurement of integrated reflection intensity. W. COCHRAN. *Acta Cryst.*, **3**, 267–78 (*July*, 1950).

Two methods are described by which integrated reflection intensity may be measured in a short time, despite the non-linear response of the Geiger counter to X-ray intensity. Some advantages and disadvantages of the balanced-filter method of monochromatization are pointed out. The relation between counting rate and X-ray intensity is dealt with from both the theoretical and practical points of view. Results obtained with the counter-spectrometer are compared with those obtained by photographic recording. A.

548.735

6170. The phases and magnitudes of the structure factors. J. KARLE AND H. HAUPTMAN. *Acta Cryst.*, **3** (*No.* 3) 181–7 (1950).

Inequalities among the coefficients of a Fourier series representing the electron density in a crystal are derived on the basis that the series represents a positive function. The procedure is formulated for obtaining all inequalities which are based on this characteristic of positiveness, and some of the simpler ones are listed. No symmetry properties are required for deriving the inequalities, but they may be readily introduced into the inequality relationships. It is indicated that application of the linear transformation theory on hermitian forms may prove fruitful in future investigation. A.

548.735

6171. The probability distribution of X-ray intensities. II. Experimental investigation and the X-ray detection of centres of symmetry. E. R. HOWELLS, D. C. PHILLIPS AND D. ROGERS. *Acta Cryst.*, **3** (*No.* 3) 210–14 (1950).

The probability distributions of reflected X-ray intensities have been investigated experimentally. The results are in agreement with the theory, and the possibility is demonstrated of distinguishing between centrosymmetric and non-centrosymmetric structures

and projections within the limitations of the theory. Details of a convenient distinguishing test are presented and the effects upon it of absorption, extinction and experimental errors in intensities are discussed. A.

548.735

6172. On the derivation of Harker–Kasper inequalities. C. H. MACGILLAVRY. *Acta Cryst.*, **3** (*No.* 3) 214–17 (1950).

Group theory leads to an easy and straightforward method. A.

548.735

6173. Precision measurements of lattice parameters of non-cubic crystals. A. TAYLOR AND R. W. FLOYD. *Acta Cryst.*, **3**, 285–9 (*July*, 1950).

It is shown that lattice parameters of non-cubic crystals can be accurately determined by linear extrapolation against the function $\frac{1}{2}(\cos^2\theta/\sin\theta + \cos^2\theta/\theta)$ by selecting lines with suitable indices. Use can be made of the slope of the extrapolation curve of one of the parameters to derive the slope of the extrapolation curve of a second parameter. By this means, a true extrapolated value of the second parameter may be obtained when only a single appropriate reflection is available. It is also shown that the observed $\sin^2\theta$ values can be accurately corrected for drift by means of an expression of the form $D\sin^2\theta\,(\cos^2\theta/\sin\theta + \cos^2\theta/\theta)$. Examples of lattice-parameter determinations and drift corrections are given for cobalt and for Ni_3Ti. A.

548.735.4

6174. Optimum conditions for convergence of steepest descents as applied to structure determination. M. M. QURASHI. *Acta Cryst.*, **2**, 404–9 (*Dec.*, 1949).

The successive approximations to a structure, given by the method of steepest descents, converge to the true values of the parameters at a rate which depends very markedly on the scales of representation chosen for these parameters. The importance of this is discussed in detail and transformations are derived which secure the optimum rate of convergence and at the same time make all the parameters mathematically equivalent. The application of these transformations leads to a simple formula for the corrections ε_i, which has considerable advantages over existing formulae for steepest descents. An illustration of the use of this formula is given from the derivation of the structure of the hexagonal ζ-phase in the Ag–Zn alloy system. A.

548.735.44

6175. A new punched-card method of Fourier synthesis. D. M. S. GREENHALGH AND G. A. JEFFREY. Note in *Acta Cryst.*, **3**, 311–12 (*July*, 1950).

548.736.1

6176. Note on the structure of uranium. J. S. LUKESH. *Acta Cryst.*, **2**, 420 (*Dec.*, 1949).

548.736.1

6177. Reflexion method for projecting crystal-structure models. J. W. HUGHES, D. C. PHILLIPS, D. ROGERS AND A. J. C. WILSON. *Acta Cryst.*, **2**, 420 (*Dec.*, 1949).

548.736.1

6178. Crystallography of rhombohedral sulfur. C. FRONDEL AND R. E. WHITFIELD. *Acta Cryst.*, **3** (*No.* 3) 242–3 (1950).

548.73

6179. X-ray diffraction studies of the syste Zn_2TiO_4–$NiTiO_3$. H. BIRNBAUM AND R. K. SCO *J. Amer. Chem. Soc.*, **72**, 1398–9 (*March*, 1950).

548.73

6180. Anomalous X-ray reflexions from cop crystals. W. A. RACHINGER. Note in *Acta Cry* **3**, 312–13 (*July*, 1950).

548.73

6181. A note on the rhombohedral modification graphite. G. E. BACON. Note in *Acta Cryst.*, 320 (*July*, 1950).

548.73

6182. On the anomalous structures of silic carbide. G. HONJO. *J. Phys. Soc. Japan*, **4**, 35 (*July–Dec.*, 1949).

548.73

6183. Solid solutions in bromine-iodine mixtur O. S. HEAVENS AND G. H. CHEESMAN. *Acta Cryst.* (*No.* 3) 197–200 (1950).

The lattice spacings of a series of solid solutio of I and Br have been determined for a range composition 0–38 mole % Br. The change of latt spacing with composition is found to be linear ov this range. The solid solution is found to belong the space group *Ccm*, suggesting that the cryst contain oriented IBr molecules. A method is describ for obtaining refined values of lattice parame from X-ray powder photographs of substances whi do not give high-angle reflections.

548.737 : 539.1

6184. The crystal and molecular structure anthracene. I. X-ray measurements. A. MC MATHIESON, J. M. ROBERTSON AND V. C. SINCLA *Acta Cryst.*, **3**, 245–56 (*July*, 1950).

A very complete redetermination of the cryst structure of anthracene is described. All t reflections that lie within the range of Cu $K\alpha$ radiatio have been recorded on equi-inclination Weissenbe exposures, and the intensities have been estimate visually by independent observers. From the results a total of 691 structure factors have bee evaluated out of a possible 1 085 (64%). The earli 2-dimensional determination of the structure has bee further refined, by revising the $(h0l)$ structure facto and the (010) projection, and from these results it ha now been possible to assign phase constants to 66 of the structure factors.

548.737 : 539.1

6185. The crystal and molecular structure anthracene. II. Structure investigation by the trip Fourier series method. V. C. SINCLAIR, J. M ROBERTSON AND A. MCL. MATHIESON. *Acta Cryst* **3**, 251–6 (*July*, 1950).

A triple Fourier series investigation of th anthracene structure is described, utilizing the 66 structure factors and phase constants listed in The electron density has been evaluated at 54 00 points over the asymmetric unit (half the chemica molecule). Sections through the separate atoms ar given, as well as an evaluation of the electron densit in the plane of the molecule. The bond lengths ca be determined by direct measurement with an accurac

mated to be of the order of 0·01 Å. They show siderable variation, from 1·36 Å for the $\alpha\beta$ bond, 9 for the $\beta\beta$ and the *om* bonds, 1·42 Å for the bond, to 1·44 Å for the *oo* bonds. These varia- is are in harmony with the chemical properties and h theoretical predictions. The molecule is planar within about 0·01 Å. The electron distribution is cussed. The H atoms are partially resolved on the electron-density maps and provide a direct measurement of the C–H distance at one position (1·10 Å). A.

548.737 : 539.133

6186. The crystal and molecular structure of 1 : 4-dimethoxybenzene. T. H. GOODWIN, M. PRZYBYLSKA AND J. M. ROBERTSON. *Acta Cryst.*, **3,** 279–84 (*July*, 1950).

GEOPHYSICS 55

550.3 : 531.35

Features of rocket kinematics in geodetic and ophysical problems. *See Abstr.* 5540

550.312 : 526.7

The determination of normal weight in geodesy. *See bstr.* 5478

ATMOSPHERE . METEOROLOGY 551.5

551.510.535 : 523.4

87. On the positive charges of planetary atmo- heres. V. A. KRAT. *Astr. J., USSR*, **26** (*No.* 4) 201 949) *In Russian.* English Abstr. in *Astr. News etter* [*Harvard*] (*No.* 47).

An analogy is drawn between the solar corona and le *F*2 layer of the ionosphere, and the equilibrium onditions of the latter studied in detail. If the earth surrounded by a vacuum, the equation of equili- rium leads to the fraction of the force of gravity ompensated by electrostatic repulsion upon the O^+ n $\beta = 0{\cdot}52$. The positive electric charge of the rth (mass m_E) Z is calculated from the relation $Z = \mathrm{gm}_E m^+ \beta$; $Z = 2{\cdot}2 \times 10^7$ e.s.u. The time equired to establish this equilibrium $\simeq 10^9$ sec. interplanetary space contains an ionized gas at ery low pressure, $Z = 2 \times 10^5$ e.s.u. The modifica- on introduced by the magnetic field of the earth is onsidered, the positive charge being concentrated in olar regions. It is suggested that the high tem- erature of the *F*2 region, the cause of which is dis- ussed, may account for the absence of free H and He the atmospheres of the earth and Venus.

M. W. OVENDEN

551.510.535 : 537.563/564

Ionization of negative oxygen ions by electron mpact. *See Abstr.* 5904

551.575 : 536.253

Experimental studies in thermal convection. *See bstr.* 5761

551.578.1 : 621.396.9 : 538.566

The scattering of ten-centimetre radio waves by rain. *ee Abstr.* 5981

551.593.13 : 522.6

Atmospheric tremor and its influence on the intensity istribution of photographic stellar images. *See bstr.* 5421

551.594.21 : 543.545 : 537.221

Electrical phenomena occurring during the freezing of dilute aqueous solutions and their possible relationship to thunderstorm electricity. *See Abstr.* 5802

551.594.51 : 621.396.9 : 621.396.826

6188. Radar reflexions from auroras. P. A. FORSYTH, W. PETRIE, F. VAWTER AND B. W. CURRIE. Letter in *Nature, Lond.*, **165,** 561–2 (*April* 8, 1950).

Radar equipment operating on frequencies 3 000 Mc/s and 106·5 Mc/s has been used to detect radio echoes from bright aurorae. Apart from the characteristic auroral "noise" on the 3 000 Mc/s channel, no echoes were found on this frequency, although well-defined and persistent echoes appeared at the lower frequency, and were obtained from bright arcs and bands up to distances of 600–1 000 km from the receiver. Resolution of the equipment in use was insufficient to decide whether reflection occurred from the lower, brighter regions of each display, or from points slightly higher. The echoes appeared similar to those normally received from the ionosphere: on this assumption, a lower limit of $1{\cdot}4 \times 10^8$ electrons/cm² was computed for the ionization density within the region of echo production. It is suggested that these regions of high electron density are the seat of the 3 000 Mc/s pulses observed during auroral displays. The absence of echoes at this frequency is explained by the limited space distribution of enhanced electron density, and the rapid diffusion of electrons following the initial ionization.

D. R. BARBER

551.594.6 : 538.566.3

6189. Longitudinal and transverse propagation in Canada. J. C. W. SCOTT. *J. Geophys. Res.*, **55,** 65–84 (*March*, 1950).

The apparent terrestrial magnetic field in the ionosphere, as calculated from measured critical-frequency differences of the extraordinary and ordinary modes, shows large diurnal and seasonal variations. The longitudinal mode, which is often seen at high magnetic latitudes, gives a consistently different field from the transverse mode. These results are explained as due to deflections of the energy path from the vertical in conjunction with variations in horizontal ionization gradients. The direction of the complex Poynting vector is calculated for the different modes. The westward component of the deflection of the longitudinal ordinary mode is shown to be as large as the north-south deflection. A.

PHOTOGRAPHY 77

771.53 : 548.526

Structure and growth mechanism of photolytic silver in silver bromide. *See Abstr.* 6148

771.535 : 539.16.08

Method of measuring the path length and the frequency of secondary groups [of nuclear particles] by means of photographic emulsions. *See Abstr.* 6031

771.535 : 539.172.4

6190. The application of photographic plates for the detection of the fission reactions of uranium. O. ROCHAT. *Mem. Soc. Vaud. Sci. Nat.*, **9** (*No.* 3) 195–240 (1949) *In French.*

The cross-section of U^{235} towards fission induced by thermal neutrons was determined to 580 ± 120 barns. The method was calibrated by comparison with the known cross-section of B. Both elements were incorporated into photographic plates. The background of α-particles was eliminated by controlled under-development, brought about by decreasing the *p*H of the developer. The known desensitiz tion of photographic plates by U salts was shown be due not only to a change in *p*H but to a mo specific effect of the U ions. The effect of the low *p* of the impregnating solution can be eliminated l bathing the plates in a solution buffered to *p*H 8 f 12 hours between exposure and development.

W. F. BEF

778.3 : 535.375

6191. A single exposure photographic method f depolarization factor measurements. P. BENDER AN P. A. LYONS. *J. Chem. Phys.*, **18**, 438–40 (*April*, 195C

A method for use in Raman spectroscopy described. The accuracy of the results was tested b measurements with CCl_4 and $CHCl_3$. The depolariz tion factors found for highly polarized lines were i good agreement with those given by the photoelectr method rather than with those of other photograph investigations.

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